Journal of Scientific Agriculture 2025, 9: 166-171
doi: 10.25081/jsa.2025.v9.9592
https://updatepublishing.com/journal/index.php/jsa

Research Article

ISSN: 2184-0261

Seed germination and dormancy characteristics of a collection of rice genotypes of northern Kerala

V. P. Karthika*, P. K. Retheesh, Rajesh Kalladan, T. Vanaja

Regional Agricultural Research Station, Kerala Agricultural University, Pilicode, Kasaragod-671310, Kerala, India

ABSTRACT

An experiment was conducted at the Regional Agricultural Research Station, Pilicode (12.20° N, 75.16° E) of Kerala Agricultural University, to study the germination and dormancy characteristics of 27 rice genotypes cultivated in northern Kerala. The study revealed the significant variation among the genotypes with respect to percentage and speed of germination. At two weeks after harvest, 'Japan Violet' and 'Manuratna' showed the highest percentage of germination whereas 'Kavungin poothala' and 'Kandorkutti' exhibited the highest dormancy. Out of the seven very strong genotypes identified, 'Kavungin poothala' could reach 80% germination at seventh month after harvest only. Irrespective of the presence of dormancy, higher mean speed of germination among genotypes was observed at two months after harvest and similar vigour was maintained up to seven months. Among the genotypes, 'Manuratna' exhibited good germination even after one year. 'Jeeakashala' and 'Chettadi' also retained viability and vigour till one year though both exhibited seed dormancy at two weeks after harvest.

Received: May 18, 2025
Revised: August 02, 2025
Accepted: August 04, 2025
Published: August 18, 2025

***Corresponding Author:**
V. P. Karthika
E-mail: karthika.vp@kau.in

KEYWORDS: Seed germination, Dormancy, Speed of germination, Rice genotypes

INTRODUCTION

Seed is the prime input in crop production. Use of quality seed alone contributes 5-20% higher yield in rice crop (Sahu *et al.*, 2020). A minimum germination of 80% is required to ensure good crop stand and better yield in rice. Seed germination in rice is governed by dormancy, viability and storage life. Strong seed dormancy and reduced viability may lead to skipping of specific cropping seasons which in turn result in financial loss to farmers.

Seed dormancy is an important survival mechanism in plants. However, it is considered as an undesirable character in crop production, as it causes delay in cropping, asynchronous germination or non-uniform maturity of grains (Delouche *et al.*, 2007). If dormancy is intense, it may restrict the seed availability for the immediate next crop. On the other hand, if dormancy is completely absent, it may lead to pre-harvest sprouting which is often noticed when unexpected heavy rains occur during the crop maturation period. Because of these traits, we have lost many genotypes in the process of domestication, even though they possess so many favourable unique characteristics. Knowledge about the dormancy period of different rice genotypes will help farmers to undertake proper measures to overcome dormancy.

Seed vigour affects the speed and uniformity of seedling emergence, the rate of plant growth and the final crop stand. In field conditions, seed lots with similar germination percentage show variation in seedling emergence (Srivastava *et al.*, 2012). Assessment of speed of germination is a method to indirectly determine the seed vigour and a seed lot is considered as vigorous if the speed of germination is high (Agrawal, 2008).

Rice occupies a pride position in the tradition of Kerala. It is cultivated in 0.21 million hectares of land with a production of 0.63 million tonnes and productivity of 3.11 t/ha in Kerala (GOK, 2023). The State is blessed with a vast number of rice genotypes each with distinguished characteristics. Hence, a collection of rice genotypes cultivated by the farmers of northern Kerala were evaluated based on the dormancy and germination characteristics.

MATERIALS AND METHODS

The study was conducted at the Regional Agricultural Research Station Pilicode (12.20° N, 75.16° E), Kerala Agricultural University. Twenty-seven rice genotypes preferred by farmers of northern Kerala, including both released varieties of Kerala Agricultural University and traditional varieties were used in this study and the laboratory experiments were conducted during

October 2022 to January 2024. The experiment was done in a Completely Randomized Design with these 27 genotypes as treatments. The genotypes used were 'Rakthashali', 'Japan violet', 'Manuratna', 'Njavara', 'Ezhome 2', 'Jeerakashala', 'Kochuvith', 'Jadathi', 'Rasagadham', 'Kandorkutti', 'Chettadi', 'Jyothi', 'Jaya', 'Chempav', 'Vellathondi', 'Jaiva', 'Kothambarikayama', 'Thavalakannan', 'Valankunjuvith', 'Uma', 'Karuthanjavara', 'Punjapparuthi', 'Karinellu', 'Ezhome 1', 'Ehome 4', 'Mithila' and 'Kavungin Poothala'. Out of these, Manuratna', 'Ezhome 1', 'Ezhome 2', 'Ezhome 4', 'Jyothi', 'Jaya', 'Jaiva', 'Uma' and 'Mithila' are varieties released from Kerala Agricultural University.

Seeds for the experiment were collected after the harvest of the Kharif crop of 2022 from the paddy production and germplasm conservation units of the Regional Agricultural Research Station. The experiment was conducted in disposable petri plates of 8.6 cm diameter and 1.2 cm height. Two filter papers were layered at the bottom of each petri plate. Twenty five seeds of each treatment were placed in petri plates and each treatment was replicated four times. The filter papers were kept moistened by distilled water throughout the observation period and each plate was monitored for 10 days after seed placement and counts of seed germination were noted daily. A seed was considered as germinated when the radicle was 2 mm in length (Vibhuti *et al.*, 2015).

The first experiment was done two weeks after harvest, after careful threshing, winnowing and drying of the harvested seeds and subsequent tests were done in monthly intervals from one month after harvest to 14 months after harvest. The seeds for the experiment were stored in containers made of polypropylene and the whole experiments were conducted at room temperature. Germination percentage was calculated from the total germination value using the following equation.

Germination percentage = [Number of germinated seeds/Total number of seeds tested] X 100

Seeds which failed to reach 80% germination were treated as dormant and the duration to reach 80% germination was treated as the period of dormancy (Kulkarni *et al.*, 2021). Germination percentage values obtained in this study were arcsine transformed for the statistical analysis. Days taken for obtaining maximum germination in each treatment were noted in all the experiments. Germination speed, which is an indication of seed vigour was calculated by counting the number of germinated seeds on each day and by adding the quotients of daily counts divided by the number of days taken for germination (Gupta, 1993; Agrawal, 2008; Khare & Bhale, 2016). The equation used is given below.

$$N = n1/1 + n2/2 + \ldots\ldots\ldots + nx/x$$

Where, n1 to nx are the number of seeds germinated on day 1 to day x, where 1 to x are the corresponding number of days.

Analysis of variance of transformed germination data and speed of germination were worked out and linear correlation analysis was done among germination percentage, speed of germination and days taken for germination and Pearson's correlation coefficient was worked out to identify the strength of the relationship between the parameters. The different statistical analyses were performed using GRAPES software following Gopinath *et al.* (2020).

RESULTS AND DISCUSSION

Seed Germination and Dormancy

The experiments showed that there are significant differences among the genotypes with respect to their germination and dormancy behavior (Table 1). 'Japan violet' exhibited 100% germination at two weeks after harvest, which was on par with 'Manuratna' (99%). Out of the 27 varieties used for the experiment, only seven genotypes reached 80% germination during two weeks after harvest and the rest exhibited dormancy at varying levels. The genotypes 'Kavungin poothala' and 'Kandorkutti' showed the highest dormancy with only 1% germination. At one month after harvest, seven genotypes viz., Kavungin Poothala', Thavalakannan', Mithila', 'Rakthashali', 'Punjapparuthi', 'Ezhome 1' and 'Rasagadham' remained dormant, whereas the other 20 varieties showed more than 80% germination, out of which 13 varieties reached 97-100% germination. The traditional varieties, 'Jeerakashala' and 'Kandorkutti' which showed 8% and 1% germination respectively at two weeks after harvest had reached 100% and 91% germination respectively at one month after harvest. The dormancy classification method adopted by Hanumanthappa *et al.* (2015) and Kulkarni *et al.* (2021) was followed to understand very strong dormant genotypes (dormancy > 28 days) in this experiment and based on that it was found that 'Thavalakannan', 'Punjapparuthi', 'Rakthashali', 'Rasagadham', 'Ezhome 1', 'Mithila' and 'Kavungin poothala' are exhibiting very strong dormancy.

In the germination test at two months after harvest, except 'Kavungin poothala' (73%), all other varieties crossed 80% germination. 'Kavungin poothala' showed its highest germination of 85% in the seventh month after harvest, before and after the germination was found to be poor. The higher period of seed dormancy in 'Kavungin poothala' is in agreement with the findings of Kulkarni *et al.* (2021) that long duration varieties exhibit a longer period of dormancy compared to early and medium duration varieties as 'Kavugin poothala' is a photosensitive, traditional, long duration rice genotype. In a study undertaken by Kirubhakaran *et al.* (2022), traditional rice varieties exhibited medium to strong dormancy immediately after harvest which got reduced subsequently.

It is noted in this study that, even at 10 months after harvest, 16 varieties maintained more than 80% germination out of which 11 showed more than 90% germination. 'Jeerakashala' exhibited 99% percent germination at 11 months after harvest which later dropped to 90% at 12 months after harvest which was on par with 'Manuratna' and 'Chettadi'. Among the 27

Table 1: Germination of rice seeds at different periods after harvest

Treatments	2 WAH	1 MAH	2 MAH	3 MAH	4 MAH	5 MAH	6 MAH	7 MAH	8 MAH	9 MAH	10 MAH	11 MAH	12 MAH	13 MAH	14 MAH
T1	25.78^{j}	50.80^{fg}	84.28^{abcd}	83.05^{abcd}	85.94^{ab}	78.94^{bc}	77.02^{cdefg}	81.39^{abc}	73.31^{fghijk}	69.42^{efghij}	54.05^{klm}	0.00^{m}	0.00^{k}	0.00^{h}	0.00^{c}
Rakthashali	(19)	(60)	(98)	(97)	(98)	(95)	(93)	(97)	(91)	(87)	(65)	(0)	(0)	(0)	(0)
T2	90.05^{a}	90.05^{a}	90.05^{a}	90.05^{a}	90.05^{a}	87.16^{ab}	90.05^{a}	90.05^{a}	83.05^{abcde}	84.98^{abcd}	78.50^{abcd}	66.02^{cd}	23.43^{hi}	2.89^{gh}	0.00^{c}
Japan violet	(100)	(100)	(100)	(100)	(100)	(99)	(100)	(100)	(97)	(97)	(96)	(83)	(16)	(1)	(0)
T3	87.16^{a}	87.16^{ab}	87.16^{ab}	90.05^{a}	78.50^{bcd}	82.09^{abc}	90.05^{a}	87.16^{ab}	84.28^{abcd}	83.05^{abcd}	69.77^{defgh}	74.83^{b}	67.50^{a}	61.04^{a}	0.00^{c}
Manurathna	(99)	(99)	(99)	(100)	(96)	(96)	(100)	(99)	(98)	(97)	(88)	(93)	(85)	(76)	(0)
T4	31.02^{ij}	73.87^{d}	84.28^{abcd}	84.28^{abc}	84.28^{abc}	87.16^{ab}	75.10^{defg}	83.05^{abc}	75.10^{efghij}	77.28^{cdefg}	76.06^{bcde}	68.25^{bcd}	37.32^{cde}	7.00^{efgh}	0.00^{c}
Njavara	(27)	(92)	(98)	(98)	(98)	(99)	(93)	(97)	(93)	(95)	(94)	(86)	(37)	(3)	(0)
T5	48.48^{f}	90.0^{a}	85.94^{abc}	90.05^{a}	78.94^{bcd}	81.39^{abc}	81.39^{abcde}	87.16^{ab}	84.98^{abc}	78.94^{bcde}	78.50^{abcd}	72.65^{bc}	52.22^{b}	38.40^{c}	5.77^{b}
Ezhome 2	(56)	(100)	(98)	(100)	(95)	(97)	(97)	(99)	(97)	(95)	(96)	(91)	(62)	(39)	(2)
T6	16.18^{k}	90.05^{a}	87.16^{ab}	87.16^{ab}	90.05^{a}	90.05^{a}	77.28^{cdefg}	90.05^{a}	84.98^{abc}	90.05^{a}	87.16^{a}	87.16^{a}	71.82^{a}	46.79^{b}	13.29^{a}
Jeerakashala	(8)	(100)	(99)	(99)	(100)	(100)	(95)	(100)	(97)	(100)	(99)	(99)	(90)	(53)	(7)
T7	47.33^{fg}	90.05^{a}	90.05^{a}	90.05^{a}	90.05^{a}	78.94^{bc}	87.16^{ab}	87.16^{ab}	76.06^{cdefghij}	87.16^{ab}	64.27^{fghij}	51.43^{fg}	27.67^{fgh}	0.00^{h}	0.00^{c}
Kochuvith	(54)	(100)	(100)	(100)	(100)	(95)	(99)	(99)	(94)	(99)	(81)	(61)	(22)	(0)	(0)
T8	53.89^{ef}	87.16^{ab}	81.39^{abcde}	90.05^{a}	65.54^{fg}	77.28^{c}	77.16^{cdefg}	69.90^{efg}	76.32^{cdefghij}	68.94^{fghij}	57.80^{ijkl}	47.36^{gh}	7.00^{j}	0.00^{h}	0.00^{c}
Jadathi	(65)	(99)	(97)	(100)	(82)	(95)	(93)	(88)	(94)	(87)	(71)	(54)	(3)	(0)	(0)
T9	15.22^{k}	62.78^{e}	76.06^{cdef}	81.39^{abcde}	84.28^{abc}	87.16^{ab}	70.73^{ghi}	74.01^{cdef}	64.41^{k}	72.09^{efghi}	4.11^{p}	2.89^{m}	0.00^{k}	0.00^{h}	0.00^{c}
Rasagadham	(7)	(79)	(94)	(97)	(98)	(99)	(89)	(90)	(81)	(90)	(2)	(1)	(0)	(0)	(0)
T10	2.89^{l}	72.91^{d}	84.28^{abcd}	90.05^{a}	87.16^{ab}	90.05^{a}	87.16^{ab}	78.94^{bcde}	77.28^{cdefghi}	87.16^{ab}	75.80^{bcde}	31.72^{j}	33.17^{ef}	11.11^{def}	0.00^{c}
Kandorkutti	(1)	(91)	(98)	(100)	(99)	(100)	(99)	(95)	(95)	(99)	(92)	(28)	(30)	(5)	(0)
T11	53.77^{ef}	90.05^{a}	84.28^{abcd}	78.94^{bcde}	81.39^{abc}	87.16^{ab}	73.52^{efg}	82.09^{abc}	78.94^{bcdefgh}	84.15^{abcd}	72.65^{cdef}	74.83^{b}	65.05^{a}	38.05^{c}	15.83^{a}
Chettadi	(65)	(100)	(98)	(95)	(97)	(99)	(91)	(96)	(95)	(96)	(91)	(93)	(82)	(38)	(10)
T12	65.19^{cd}	81.39^{c}	83.05^{abcde}	90.05^{a}	84.98^{abc}	76.32^{c}	84.28^{abc}	74.14^{cdef}	81.39^{abcdef}	76.06^{defgh}	83.05^{ab}	67.37^{bcd}	43.85^{c}	0.00^{h}	0.00^{c}
Jyothi	(82)	(97)	(97)	(100)	(97)	(94)	(98)	(92)	(97)	(94)	(97)	(85)	(48)	(0)	(0)
T13	46.77^{fg}	87.16^{ab}	87.16^{ab}	90.05^{a}	81.83^{abc}	75.10^{cd}	80.87^{bcde}	82.0 ^{abc}	75.49^{defghij}	70.86^{efghij}	65.79^{fghi}	66.54^{cd}	35.64^{de}	0.00^{h}	0.00^{c}
Jaya	(53)	(99)	(99)	(100)	(96)	(93)	(95)	(96)	(93)	(89)	(83)	(84)	(34)	(0)	(0)
T14	25.27^{j}	70.73^{d}	79.21^{bcdef}	74.83^{def}	78.94^{bcd}	79.91^{bc}	77.28^{cdefg}	64.03^{g}	73.87^{fghij}	66.54^{hij}	63.01^{ghijk}	27.06^{jk}	0.00^{k}	0.00^{h}	0.00^{c}
Chempav	(19)	(89)	(95)	(93)	(95)	(94)	(95)	(80)	(92)	(84)	(79)	(21)	(0)	(0)	(0)
T15	75.10^{b}	84.28^{bc}	84.28^{abcd}	90.05^{a}	83.05^{abc}	80.87^{bc}	80.17^{bcdef}	78.94^{bcde}	78.50^{bcdefgh}	75.80^{defgh}	73.05^{cdef}	62.71^{de}	37.42^{cde}	0.00^{h}	0.00^{c}
Vellathondi	(93)	(98)	(98)	(100)	(97)	(95)	(96)	(95)	(96)	(92)	(91)	(77)	(37)	(0)	(0)
T16	74.05^{b}	84.28^{bc}	70.30^{f}	80.04^{bcde}	66.81^{efg}	66.54^{de}	61.64^{ij}	74.74^{cdef}	71.73^{ghijk}	62.83^{ij}	58.77^{ijkl}	56.48^{ef}	33.19^{ef}	8.66^{efg}	0.00^{c}
Jaiva	(91)	(98)	(88)	(94)	(84)	(84)	(77)	(92)	(89)	(78)	(73)	(69)	(30)	(3)	(0)
T17 Kothambari	39.83^{gh}	72.91^{d}	73.31^{ef}	84.28^{abc}	74.97^{cdef}	61.49^{e}	77.02^{cdefg}	67.37^{fg}	68.86^{ijk}	68.33^{fghij}	39.20^{n}	19.19^{kl}	0.00^{k}	0.00^{h}	0.00^{c}
kayama	(41)	(91)	(91)	(98)	(91)	(77)	(93)	(85)	(86)	(86)	(40)	(11)	(0)	(0)	(0)
T18	25.78^{j}	45.60^{g}	75.45^{def}	83.05^{abcd}	77.02^{bcde}	87.16^{ab}	69.90^{ghi}	67.64^{fg}	75.10^{efghij}	65.31^{ij}	71.65^{cdefg}	5.77^{m}	0.00^{k}	0.00^{h}	0.00^{c}
Thavalakannan	(19)	(51)	(91)	(97)	(93)	(99)	(88)	(85)	(93)	(82)	(86)	(2)	(0)	(0)	(0)
T19	58.03^{de}	74.14^{d}	81.39^{abcde}	84.28^{abc}	82.09^{abc}	76.20^{c}	71.08^{fgh}	72.09^{defg}	81.27^{abcdef}	67.72^{ghij}	66.54^{efghi}	49.67^{fg}	40.24^{cd}	4.11^{fgh}	0.00^{c}
Valankunjuvith	(71)	(92)	(97)	(98)	(96)	(92)	(89)	(90)	(95)	(84)	(84)	(58)	(42)	(2)	(0)
T20	62.68^{cd}	90.05^{a}	87.16^{ab}	87.16^{ab}	90.05^{a}	81.39^{abc}	83.05^{abcd}	84.28^{ab}	87.16^{ab}	85.94^{abc}	77.72^{abcd}	72.36^{bc}	25.40^{gh}	12.42^{de}	0.00^{c}
Uma	(78)	(100)	(99)	(99)	(100)	(97)	(97)	(98)	(99)	(98)	(94)	(88)	(19)	(7)	(0)
T21	73.27^{b}	84.28^{bc}	85.94^{abc}	80.04^{bcde}	83.05^{abc}	90.05^{a}	90.05^{a}	90.05^{a}	80.17^{bcdefg}	84.28^{abcd}	80.87^{abc}	73.05^{bc}	31.82^{efg}	8.66^{efg}	0.00^{c}
Karuthanjavara	(88)	(98)	(98)	(94)	(97)	(100)	(100)	(100)	(96)	(98)	(95)	(91)	(28)	(3)	(0)
T22	13.99^{k}	53.78^{f}	77.63^{bcdef}	75.93^{cde}	87.16^{ab}	79.21^{bc}	80.17^{bcdef}	75.10^{cdef}	84.28^{abcd}	71.08^{efghij}	61.88^{hijkl}	33.71^{ij}	0.00^{k}	0.00^{h}	0.00^{c}
Punjapparuthi	(6)	(65)	(93)	(92)	(99)	(95)	(96)	(93)	(98)	(89)	(77)	(31)	(0)	(0)	(0)
T23	60.08^{cde}	73.52^{d}	73.31^{ef}	66.81^{fg}	69.29^{defg}	66.68^{de}	62.09^{hij}	64.35^{g}	68.11^{jk}	61.65^{j}	47.35^{mn}	0.00^{m}	7.00^{j}	0.00^{h}	0.00^{c}
Karinellu	(75)	(91)	(91)	(84)	(87)	(84)	(78)	(81)	(85)	(77)	(54)	(0)	(3)	(0)	(0)
T24	27.27^{j}	55.00^{f}	83.05^{abcde}	72.44^{ef}	79.30^{bcd}	75.49^{c}	82.09^{abcde}	84.28^{ab}	82.09^{abcdef}	70.12^{efghij}	55.66^{jklm}	17.49^{l}	18.36^{i}	0.00^{h}	0.00^{c}
Ezhome 1	(21)	(67)	(97)	(88)	(93)	(93)	(96)	(98)	(96)	(88)	(68)	(10)	(10)	(0)	(0)
T25	67.37^{bc}	70.73^{d}	80.87^{abcde}	84.28^{abc}	81.83^{abc}	90.05^{a}	84.28^{abc}	79.21^{bcd}	69.90^{hijk}	65.05^{ij}	53.40^{lm}	41.53^{hi}	36.75^{de}	17.75^{d}	2.89^{bc}
Ehome 4	(85)	(89)	(95)	(98)	(96)	(100)	(98)	(95)	(88)	(82)	(64)	(44)	(36)	(10)	(1)
T26	38.02^{hi}	49.63^{fg}	77.72^{bcdef}	80.17^{bcde}	80.87^{abc}	80.17^{bc}	84.98^{abc}	78.94^{bcde}	90.05^{a}	77.98^{bcdef}	77.02^{bcd}	60.90^{de}	52.81^{b}	10.14^{efg}	2.89^{bc}
Mithila	(38)	(58)	(94)	(96)	(95)	(96)	(97)	(95)	(100)	(94)	(93)	(76)	(63)	(6)	(1)
T27	2.89^{l}	21.94^{h}	59.52^{g}	59.75^{g}	59.84^{g}	58.11^{e}	58.95^{j}	67.58^{fg}	53.17^{l}	47.52^{k}	29.02^{o}	19.67^{kl}	0.00^{k}	0.00^{h}	0.00^{c}
Kavungin Poothala	(1)	(14)	(73)	(74)	(74)	(72)	(73)	(85)	(64)	(54)	(24)	(12)	(0)	(0)	(0)
SE (m)+	2.777	1.980	3.616	3.240	3.793	3.122	3.247	3.222	3.238	3.465	3.411	2.881	2.448	2.691	1.725
LSD (0.05)	7.814	5.572	10.176	9.117	10.672	8.786	9.136	9.065	9.110	9.749	9.599	8.106	6.888	7.572	4.855

WAH = weeks after harvest; MAH = Months after harvest. Data presented in table is arcsine transformed values of germination percentage and the actual germination percentage is presented in parenthesis. Treatments with same alphabets as superscripts do not differ significantly

genotypes tested, 'Manuratna' retained its viability beyond one year. Though 'Jeerakashala' and 'Chettadi' exhibited initial dormancy, seeds remained viable up to one year. At 13 months after harvest, all the treatments showed less than 80% germination and the highest germination among them was observed in 'Manuratna' (76%).

The problem of in situ rice seed sprouting in the field as well as in the threshing yard in Kuttanad area (which is known as the rice bowl of Kerala), was overcome through the development of high yielding varieties like 'Uma' and 'Revathy' which possess three weeks of seed dormancy (Devika *et al.*, 2004). They also reported that 'Jyothi' variety is nondormant. Similar results with respect to 'Uma' and 'Jyothi' were obtained in this study also.

Days Taken for Germination and Speed of Germination

The mean number of days taken for germination by the different rice genotypes is presented in Table 2. When the rice seeds were tested for germination two weeks after harvest, it took 5.11 days to achieve the maximum germination. Thereafter, the number of days reduced in subsequent experiments and reached a minimum when sown six months after harvest. However, the days taken for germination began to increase beyond six months after harvest. The mean days taken for maximum germination by the genotypes from two months after harvest to nine months after harvest were found to be below four days and it varied between 2.69 to 3.85 days.

The speed of germination of rice genotypes during different periods after harvest is presented in Table 3. The mean germination speed of the rice genotypes was highest during the two months after harvest and thereafter, the speed was found to be decreasing. Good seed vigour in rice was seen from two to seven months after harvest. Before two months and beyond seven months after harvest, the speed of germination was low. Among the various genotypes used for the study, the highest speed of germination during two weeks after harvest was seen in 'Manuratna' and it exhibited the highest vigour at 13 months after harvest also. At two weeks after harvest, the lowest germination speed was in 'Kavungin poothala', which was on par with 'Kandorkutty', 'Punjapparuthi', 'Rasagadham' and 'Jeerakashala'. Thereafter all other genotypes improved seed vigour except 'Kavungin poothala' which remained as least vigourous genotype in all the experiments. At four months after harvest, 18 genotypes out of the 27 showed the highest germination speed.

Correlation Analysis

The linear correlation analysis between the germination percentage and speed of germination showed a highly significant positive correlation (0.965***) between these parameters. Highly significant negative correlations were observed between germination percentage and days to germination (-0.418***) and between speed of germination and days to germination (-0.576***). All these correlations were found to be significant at the 0.001 level of P-value. The results were in accordance with the study of Chinnasamy *et al.* (2021), in which the correlation coefficient obtained between germination percentage and speed of germination was highly significant and positive (0.907). The negative highly significant relation was also reported in their study for hourly data of mean germination with germination percentage and speed of germination.

Table 2: Days taken for germination at different periods after harvest

Treatments	2 WAH	1 MAH	2 MAH	3 MAH	4 MAH	5 MAH	6 MAH	7 MAH	8 MAH	9 MAH	10 MAH	11 MAH	12 MAH	13 MAH	14 MAH
T1 Rakthashali	7.00	7.00	4.50	2.75	2.50	4.50	4.00	3.00	4.00	4.25	4.00	-	-	-	-
T2 Japan violet	4.00	2.25	2.00	3.00	2.25	2.25	2.00	2.00	3.00	2.50	3.75	5.00	4.25	2.00	-
T3 Manurathna	4.25	3.00	2.50	2.00	2.25	3.00	3.00	2.75	4.25	4.00	3.25	4.25	3.75	3.75	-
T4 Njavara	4.75	4.00	3.00	2.50	2.50	2.50	2.00	3.50	3.75	3.00	3.25	6.00	4.25	3.50	-
T5 Ezhome 2	6.00	3.25	2.50	2.00	2.00	4.00	2.50	3.25	3.75	3.00	3.25	3.75	4.75	4.75	7.00
T6 Jeerakashala	3.25	3.25	2.00	2.75	2.50	3.00	2.50	3.00	3.25	3.00	3.50	3.00	3.50	4.00	5.33
T7 Kochuvith	4.75	3.25	2.50	2.00	2.25	2.75	2.25	3.25	3.00	3.25	3.75	4.25	4.50	-	-
T8 Jadathi	5.50	3.50	2.25	3.25	3.25	3.00	3.25	3.00	3.50	3.25	4.75	6.00	5.00	-	-
T9 Rasagadham	3.50	3.75	2.00	2.75	2.25	2.50	2.75	2.25	3.25	2.50	4.00	5.00	-	-	-
T10 Kandorkutti	3.00	3.25	2.75	2.00	2.50	3.00	2.25	2.50	3.00	2.50	3.75	6.25	5.00	3.33	-
T11 Chettadi	4.50	3.00	3.00	2.75	2.25	2.75	2.00	3.50	4.00	3.50	3.75	5.00	4.25	3.00	6.00
T12 Jyothi	5.50	3.50	2.00	2.75	2.50	3.00	2.25	2.25	3.25	4.00	4.50	5.25	5.25	-	-
T13 Jaya	4.75	3.25	2.75	3.00	2.50	3.00	2.00	4.00	3.75	3.25	5.00	5.75	4.50	-	-
T14 Chempav	5.00	6.50	4.50	3.75	3.50	3.25	3.25	4.25	5.00	4.50	6.50	6.75	-	-	-
T15 Vellathondi	7.50	3.50	3.50	2.75	3.50	3.25	3.25	3.50	4.75	4.75	5.00	5.50	5.25	-	-
T16 Jaiva	6.00	3.50	2.50	3.00	2.50	3.00	2.50	3.50	3.50	3.50	4.25	6.50	5.00	2.33	-
T17 Kothambarikayama	7.50	5.25	2.75	3.75	3.75	3.50	2.50	2.75	5.50	4.00	7.00	5.75	-	-	-
T18 Thavalakannan	6.75	6.50	5.00	4.00	2.75	3.50	3.25	3.50	4.75	4.25	6.50	7.50	-	-	-
T19 Valankunjuvith	5.25	4.50	3.25	2.75	3.00	3.00	3.25	3.75	4.25	3.25	4.00	6.00	5.25	4.00	-
T20 Uma	4.50	3.25	3.00	3.00	3.00	3.00	3.25	3.50	3.75	3.75	5.25	5.50	4.75	4.67	-
T21 Karuthanjavara	5.00	3.00	2.50	2.75	2.00	2.00	2.00	3.00	2.75	2.50	2.75	4.75	4.50	4.00	-
T22 Punjapparuthi	4.25	4.00	2.00	2.00	2.50	2.75	2.25	3.25	3.50	3.75	4.00	6.25	-	-	-
T23 karinellu	6.50	4.50	3.50	3.25	3.25	3.00	2.75	3.00	3.75	3.25	5.50	-	3.00	-	-
T24 Ezhome 1	5.00	6.00	4.00	3.00	3.00	2.75	2.50	3.75	3.50	3.00	6.00	4.75	4.50	-	-
T25 Ehome 4	5.50	4.25	3.75	3.00	3.00	3.00	2.75	3.50	5.00	5.25	5.25	5.75	5.50	3.00	3.00
T26 Mithila	4.50	4.50	4.00	3.75	3.00	3.50	3.25	3.75	4.50	4.50	5.00	6.50	4.50	6.50	4.00
T27 Kavungin Poothala	4.00	4.75	4.25	3.25	3.00	4.25	3.25	3.25	3.75	4.00	8.00	6.00	-	-	-
Mean	5.11	4.08	3.05	2.87	2.71	3.07	2.69	3.20	3.85	3.56	4.65	5.48	4.56	3.76	5.07

WAH = weeks after harvest; MAH = Months after harvest

Table 3: Speed of germination of rice seeds at different periods after harvest

Treatments	2 WAH	1 MAH	2 MAH	3 MAH	4 MAH	5 MAH	6 MAH	7 MAH	8 MAH	9 MAH	10 MAH	11 MAH	12 MAH	13 MAH	14 MAH
T1 Rakthashali	1.35^{ij}	6.17^{ij}	11.78^{defg}	11.96^{bcd}	11.75^{abcde}	11.15^{jkl}	11.35^{defgh}	11.38^{bcdefghi}	9.02^{ij}	10.18^{bcd}	6.00^{hi}	0.00^{m}	0.00^{k}	0.00^{e}	0.00^{c}
T2 Japan violet	9.54^{b}	12.46^{a}	13.25^{ab}	12.79^{ab}	12.42^{a}	12.71^{b}	12.50^{a}	12.63^{a}	11.63^{abc}	12.00^{a}	11.19^{ab}	6.93^{de}	1.32^{hij}	0.13^{e}	0.00^{c}
T3 Manurathna	10.80^{a}	12.15^{a}	12.92^{bc}	13.13^{a}	11.92^{abc}	12.04^{bcdefgh}	12.29^{ab}	12.13^{abc}	10.69^{cde}	11.81^{a}	10.04^{bc}	9.82^{ab}	9.23^{a}	12.13^{a}	0.00^{c}
T4 Njavara	2.23^{hi}	10.47^{d}	12.42^{bcde}	12.21^{abc}	12.13^{abc}	13.54^{a}	11.63^{bcdef}	11.83^{abcdef}	10.40^{def}	11.57^{a}	10.40^{abc}	7.23^{cd}	2.99^{de}	0.30^{de}	0.00^{c}
T5 Ezhome 2	4.72^{fg}	11.94^{a}	12.46^{bcd}	12.6 ^{ab}	11.88^{abcd}	11.95^{bcdefghi}	12.02^{abcde}	12.04^{abcd}	10.74^{cde}	11.54^{a}	10.87^{abc}	10.04^{a}	4.89^{c}	3.75^{c}	0.08^{c}
T6 Jeerakashala	0.65^{jkl}	12.11^{a}	12.38^{bcde}	11.54^{cde}	12.29^{ab}	12.25^{bcde}	11.79^{abcde}	12.23^{ab}	9.23^{ghij}	11.79^{a}	10.43^{abc}	8.54^{abc}	8.17^{b}	6.33^{b}	0.41^{b}
T7 Kochuvith	4.43^{g}	12.07^{a}	12.42^{bcde}	12.63^{ab}	12.46^{a}	11.67^{cdefghij}	12.33^{ab}	11.96^{abcde}	9.46^{fghij}	11.48^{a}	8.06^{ef}	5.59^{efgh}	1.86^{ghi}	0.00^{e}	0.00^{c}
T8 Jadathi	5.33^{fg}	11.85^{a}	12.54^{bcd}	11.85^{bcd}	9.10^{h}	11.46^{fghijk}	11.23^{efgh}	11.00^{fghij}	10.09^{defg}	8.86^{efghij}	6.83^{fgh}	4.27^{hi}	0.17^{k}	0.00^{e}	0.00^{c}
T9 Rasagadham	0.54^{jkl}	7.99^{fgh}	12.13^{cdef}	11.21^{def}	12.17^{ab}	12.29^{bcd}	10.90^{fgh}	11.17^{efghij}	9.34^{ghij}	11.08^{abc}	0.15^{l}	0.05^{m}	0.00^{k}	0.00^{e}	0.00^{c}
T10 Kandorkutti	0.08^{kl}	10.25^{d}	13.37^{ab}	12.63^{ab}	11.54^{abcde}	12.33^{bc}	12.33^{ab}	11.79^{abcdef}	11.46^{abc}	12.13^{a}	10.07^{bc}	1.85^{jkl}	2.00^{fgh}	0.44^{de}	0.00^{c}
T11 Chettadi	5.46^{fg}	11.79^{ab}	14.2 ^{a}	11.46^{cde}	12.08^{abc}	12.25^{bcdef}	11.38^{cdefgh}	11.63^{bcdef}	10.83^{bcde}	11.66^{a}	10.03^{bc}	8.49^{bc}	7.80^{b}	5.52^{b}	0.70^{a}
T12 Jyothi	7.78^{cd}	11.54^{abc}	13.38^{ab}	12.13^{bcd}	11.60^{abcde}	11.5^{defghij}	12.21^{abc}	11.46^{bcdefgh}	10.98^{abcd}	11.33^{ab}	10.62^{abc}	6.48^{def}	3.75^{d}	0.00^{e}	0.00^{c}
T13 Jaya	4.38^{g}	11.98^{a}	12.75^{bcd}	12.09^{bcd}	11.79^{abcde}	11.21^{ijkl}	11.88^{abcde}	11.52^{bcdefg}	9.71^{fghi}	9.79^{defg}	8.64^{de}	6.35^{def}	2.59^{efg}	0.00^{e}	0.00^{c}
T14 Chempav	1.48^{ij}	7.04^{hi}	10.04^{hi}	10.65^{ef}	10.72^{efg}	10.23^{mn}	11.26^{defgh}	9.18^{lmn}	8.60^{jk}	7.68^{j}	6.06^{hi}	1.10^{klm}	0.00^{k}	0.00^{e}	0.00^{c}
T15 Vellathondi	8.20^{c}	10.77^{cd}	11.92^{cdef}	12.2^{abc}	11.63^{abcde}	11.34^{hijk}	11.77^{abcde}	11.25^{defghi}	10.00^{efgh}	9.97^{cdef}	8.53^{de}	6.27^{def}	2.72^{ef}	0.00^{e}	0.00^{c}
T16 Jaiva	9.36^{b}	10.86^{bcd}	11.04^{fgh}	11.38^{cde}	10.42^{fg}	10.25^{mn}	9.50^{i}	11.17^{efghij}	8.92^{ij}	9.03^{defghi}	7.02^{fgh}	5.17^{fgh}	2.15^{fg}	0.44^{de}	0.00^{c}
T17 Kothambarikayama	2.96^{h}	8.84^{ef}	11.23^{fg}	12.04^{bcd}	10.46^{fg}	9.303^{o}	11.50^{bcdefg}	10.38^{jk}	8.91^{ij}	9.21^{defgh}	2.85^{k}	0.51 ^{lm}	0.00^{k}	0.00^{e}	0.00^{c}
T18 Thavalakannan	1.15^{jk}	3.88^{l}	9.52^{i}	10.26^{fg}	11.54^{abcde}	11.46^{efghijk}	10.65^{gh}	9.90^{kl}	8.71^{j}	8.51^{hij}	6.61^{gh}	0.07^{m}	0.00^{k}	0.00^{e}	0.00^{c}
T19 Valankunjuvith	5.76^{ef}	8.87^{ef}	11.69^{defg}	11.83^{bcd}	11.08^{cdef}	10.54^{lm}	10.56^{h}	10.52^{ijk}	8.8 ^{ij}	8.77^{fghij}	7.66^{efg}	4.56^{ghi}	3.12^{de}	0.13^{e}	0.00^{c}
T20 Uma	6.64^{e}	10.69^{cd}	11.75^{defg}	12.00^{bcd}	11.83^{abcd}	11.17^{ijkl}	11.63^{bcdef}	10.75^{ghijk}	9.08^{hij}	9.33^{defgh}	7.22^{fgh}	6.07^{defg}	1.14^{ij}	0.47^{de}	0.00^{c}
T21 Karuthanjavara	10.31^{ab}	11.90^{a}	13.25^{ab}	11.54^{cde}	12.50^{a}	12.5^{b}	12.50^{a}	8.37^{n}	11.79^{a}	12.13^{a}	11.46^{a}	8.81^{ab}	2.42^{efg}	0.21^{de}	0.00^{c}
T22 Punjapparuthi	0.41^{jkl}	7.54^{gh}	12.38^{bcde}	11.50^{cde}	11.75^{abcde}	11.71^{cdefghij}	11.96^{abcde}	11.36^{cdefghi}	11.74^{ab}	10.04^{cde}	9.68^{cd}	2.19^{jk}	0.00^{k}	0.00^{e}	0.00^{c}
T23 karinellu	6.74^{de}	9.11^{e}	10.77^{gh}	9.48^{g}	9.81^{gh}	9.54^{no}	9.42^{i}	9.37^{lm}	7.75^{k}	7.98^{ij}	4.39^{j}	0.00^{m}	0.31^{k}	0.00^{e}	0.00^{c}
T24 Ezhome 1	1.38^{ij}	6.0 ^{jk}	10.80^{gh}	10.34^{fg}	11.23^{bcdef}	11.42^{ghijk}	11.83^{abcde}	11.99^{abcde}	9.52^{fghij}	8.29^{hij}	5.04^{ij}	0.58^{lm}	0.71^{jk}	0.00^{e}	0.00^{c}
T25 Ehome 4	8.18^{c}	8.05^{fg}	11.34^{efg}	11.96^{bcd}	11.73^{abcde}	12.21^{bcdefg}	12.11^{abcd}	11.46^{bcdefgh}	9.42^{ghij}	8.73^{ghij}	6.17^{hi}	3.30^{ij}	3.19^{de}	1.02^{d}	0.08^{c}
T26 Mithila	3.25^{h}	5.15^{k}	10.04^{hi}	10.38^{fg}	10.83^{defg}	10.71^{klm}	11.73^{abcdef}	10.64^{hijk}	8.95^{ij}	8.63^{ghij}	7.84^{efg}	5.91^{defg}	5.64^{c}	0.39^{de}	0.06^{c}
T27 Kavungin Poothala	0.06^{l}	0.90^{m}	6.84^{j}	8.25^{h}	7.96^{i}	7.175^{p}	8.48^{j}	8.98^{mn}	5.13^{l}	5.50^{k}	1.14^{l}	0.62^{lm}	0.00^{k}	0.00^{e}	0.00^{c}
Mean	**4.56**	**9.34**	**11.80**	**11.56**	**11.36**	**11.33**	**11.43**	**11.04**	**9.66**	**9.96**	**7.59**	**4.47**	**2.45**	**1.16**	**0.05**
SE (m)±	**0.384**	**0.347**	**0.396**	**0.351**	**0.385**	**0.281**	**0.304**	**0.308**	**0.336**	**0.436**	**0.452**	**0.544**	**0.294**	**0.295**	**0.072**
LSD (0.05)	**1.08**	**0.976**	**1.115**	**0.988**	**1.082**	**0.791**	**0.857**	**0.867**	**0.946**	**1.226**	**1.271**	**1.531**	**0.827**	**0.831**	**0.203**

WAH = weeks after harvest; MAH = months after harvest. Treatments with same alphabets as superscripts do not differ significantly.

CONCLUSION

From this study, it can be concluded that there is significant variation among the genotypes with respect to their germination and dormancy characteristics. Among the 27 genotypes used in this study, 'Manuratna' possessed more than 80% germination even one year after harvest. Despite initial dormancy, 'Jeeakashala' and 'Chettadi' also showed 90% and 82% viability during 12 months after harvest. 'Japan Violet' (100%) and 'Manuratna' (99%) showed higher germination at two weeks after harvest, whereas 'Kavungin poothala' and 'Kandorkutti' showed the highest dormancy with only 1% germination. Out of the 27 test genotypes, seven were found to be very strong dormant and 'Kavungin poothala' showed above 80% germination only during seven months after harvest.

Prior knowledge about the dormancy characteristics will be helpful for the farmers in the selection of suitable genotypes according to the cropping periods. It will eliminate asynchronous crop stands and ensure uniform harvest. Weak to moderate dormant genotypes can be used to overcome pre-harvest sprouting in susceptible areas or can be utilized in crop improvement programmes planned with such objectives.

REFERENCES

Agrawal, R. L. (2008). *Seed Technology*. New Delhi, India: Oxford and IBH Publishing Co. Pvt. Ltd.

Chinnasamy, G. P., Sundareswaran, S., Renganayaki, P. R., & Vetivel, M. (2021). Radicle emergence test as a quick vigour test to predict field emergence performance in rice (*Oryza sativa* L.) seed lots. *Journal of Applied and Natural Science, 13*(S1), 86-93. https://doi.org/10.31018/jans.v13iSI.2805

Delouche, J. C., Burgos, N. R., Gealy, D. R., De San Martin, G. Z., Labrada, R., Larinde, M., & Rosell, C. (2007). *Weedy rices: Origin, biology, ecology, and control* (FAO Plant Production and Protection Paper No. 188, 144 p.). Rome, Italy: Food and Agriculture Organization of the United Nations.

Devika, R., Bai, N. R., & Kumary, S. L. (2004). 'Uma' (MO 16) and 'Revathy' (MO 17): Two promising rice varieties with seed dormancy. *Journal of Tropical Agriculture, 42*, 13-16.

GOK. (2023). *A compendium of agricultural statistics: Kerala 2023*. Government of Kerala, Directorate of Agriculture Development and Farmers' Welfare.

Gopinath, P. P., Parsad, R., Joseph, B., & Adarsh, V. S. (2020). *GRAPES (General R-shiny based analysis platform empowered by statistics): Web application for data analysis in agriculture*.

Gupta, P. C. (1993). Seed vigour testing. In P. K. Agrawal (Ed.), *Handbook of seed testing* (pp. 242-249). Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.

Hanumanthappa, D., Vasudevan, S. N., Ibrahim, M., Shakuntala, N. M., Amaregouda, A., & Doddagoudar S. R. (2015). Studies on seed dormancy in paddy genotypes. *The Ecosan, 9*(1&2), 261-263.

Khare, D., & Bhale, M. S. (2016). *Seed technology*. Jodhpur, India: Scientific Publishers.

Kirubhakaran, S., Raja, K., Jerlin, R., & Chandrakumar, K. (2022). Assessment

of status of seed dormancy in traditional rice varieties. *The Pharma Innovation Journal, 11*(8), 830-835. https://doi.org/10.22271/tpi.2022.v11.i8Sk.14854

Kulkarni, C. C., Lenka, D., Muduli, K. C., Bastia, D. N., Mohanty, S., Panda, R. K., Swain, S. K. & Monalisa, S. P. (2021). Assessment of seed dormancy in different rice varieties. *Biological Forum – An International Journal, 13*(4), 140-146.

Sahu, R. K., Patnaik, S. S. C., & Sah, R. P. (2020). *Quality seed production in rice – NRRI research bulletin No. 27*. Cuttack, India: ICAR-NRRI.

Srivastava, A., Singh, P., Maurya, M., & Chaudhary, A. (2012). Vigour assessment in rice (*Oryza sativa* L.) genotypes and their correlation to field emergence. *Current Advances in Agricultural Sciences, 4*(1), 60-61.

Vibhuti, V., Shahi, C., Bargali, K., & Bargali, S. S. (2015). Seed germination and seedling growth parameters of rice (*Oryza sativa*) varieties as affected by salt and water stress. *Indian Journal of Agricultural Sciences, 85*(1), 102-108. https://doi.org/10.56093/ijas.v85i1.46046