Bangladesh J. Bot. **54**(2): 397-401, 2025 (June) **- Short communication**
DOI: https://doi.org/10.3329/bjb.v54i2.80313

EVALUATION OF SEED STORAGE POTENTIAL IN RICE LANDRACES, INDIA

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Keywords: Rice, Landraces, Seed storage, Seedling vigour

Abstract

Identifying and utilizing the superior storage potential of seeds in landraces with distinctive characteristics are crucial to withstand adverse environmental changes, seed conservation and breed a new variety. As a result, an experiment was conducted to assess the storage potential of 17 important rice landraces. The results showed that the seeds of all the landraces have maintained maximum germination (>80%) for 12 months under ambient condition except Thulasi vasanai, which retained required viability upto 11 months only. Also, Karuppu kavuni has excelled in seed storage and recoded 82% germination at 20 months and the landraces Idly (88%) and Navara (86%) had greater germination up to 18 months. Thus, Karuppu kavuni, Idly and Navara are the superior landraces remarkably with good storage potential that could be suggested for the crop improvement programme.

Seed deterioration during storage is an inevitable process that depends on the seed storage environment *viz.*, moisture, temperature, relative humidity and genetic makeup of the seed (Rao *et al*. 2006). Generally, the seed deterioration in traditional rice varieties is less than domestically cultivated varieties due to the increased antioxidant enzyme activities (Zhang *et al*. 2010). Breeders are concentrating on developing new, high-yielding cultivars to meet the growing demand for food and nutrients. Therefore, the most important requirements for rice production are the development of a high-yielding traditional medicinal rice variety and the sustainability of the seed supply system. In this context, knowledge about the storage potential of indigenous cultivars is useful in assisting researchers to maintain seed security, nutritional security and the ability to combat future climate change issues. Therefore, the current research was done on some of the significant landraces to evaluate their seed storage potential.

The traditional rice varieties were collected at farmers' locations from different regions of Tamil Nadu and raised at wetlands of Tamil Nadu Agricultural University, Coimbatore for purification and multiplication. After multiplication of varieties, the storage experiment was conducted at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, India during 2020-23. The freshly harvested seeds of 17 traditional rice varieties (Table 1) were cleaned immediately after harvesting and dried to a safe moisture level of 12 percent and packed in the cloth bag. Then, the seeds were stored at ambient conditions to assess the storability of the seeds. The samples were drawn every month and evaluated for viability and vigour.

The germination test was conducted in four replicates of 100 seeds each taken at random from each variety and placed on paper medium and allowed to germinate at 25±2°C and 95±2 % relative humidity. After 14 days, the seedlings were evaluated and the germination percent was calculated (ISTA 2022). The seeds that did not produce seedlings but remained viable and fresh at the end of the germination test were categorized as fresh un-germinated seeds (FUG). Therefore, the FUG seeds were counted, calculated the mean and expressed in percentage.

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During the germination count, ten normal seedlings were chosen at random from each replication and measured for seedling length. Then, the vigour index was calculated by multiplying germination percent with seedling length and expressed in whole number (Abdul-Baki and Anderson 1973).

According to Panse and Sukhatme (1985), the "F" test was utilized to evaluate the significance of data from the experiment. The percentage values were, if necessary, converted to angular (arc-sine) values before statistical analysis. The Standard Error Deviation (SEd) and Critical Difference (CD) were computed to compare treatment differences at 5% significance level.

Results of the present study revealed that the landraces *viz*., Samba mosanum, Idly, Kullankar, Athur kichili samba, Navara, Karuppu kavuni, Sorna masuri, Anaikomban and Milagu samba had minimum germination (<80%) during the initial period of the test due to the existence of dormancy and the dormancy get released and recorded with higher germination in subsequent months (Table 1).

With respect to the initial germination test, the fresh ungerminated seeds or dormant seeds were also found in the majority of the landraces in addition to normal and abnormal seedling percentages. After harvest, minimum germination of less than 80% was observed in Samba mosanum, Idly, Kullankar, Athur kichili samba, Navara, Karuppu kavuni, Sorna masuri, Anai komban and Milagu samba (Table 1). Fig. 1 depicts the varieties that have more fresh ungerminated seeds due to seed dormancy for a specific period i.e. two months to 11 months and it decreases naturally during storage at ambient conditions. However, the varieties *viz*., Illuppaipoo samba, Thulasi vasanai, Kalanamak, Seeraga samba, Mysore malli, Kuzhiyadichan, Norungan and Poovan samba have recorded more than 80 percent germination during the initial evaluation itself which showed no dormancy in it.

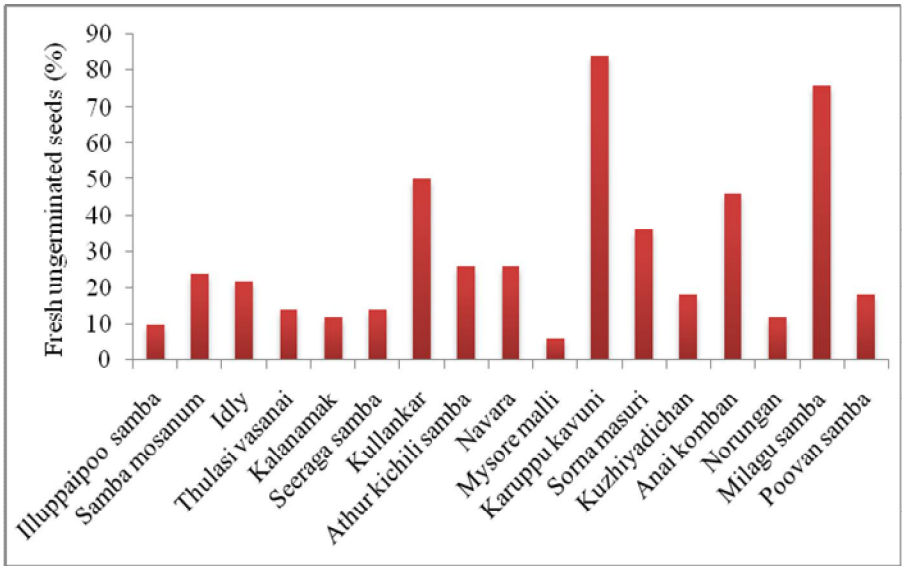

Fig. 1. Fresh ungerminated seeds during storage of rice landraces.

With respect to storage, most of the traditional rice varieties have retained their viability for nine months from the date of the initial test period and meet the prescribed standards for germination (80%). The results found that the landraces *viz*., Illuppaipoo samba, Samba mosanum,

Table 1. Effect of storage on seed germination in rice landraces

Varieties	Germination (%)																					
	Initial	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	7 MAS	8 MAS	9 MAS	10 MAS	11 MAS	12 MAS	13 MAS	14 MAS	15 MAS	16 MAS	17 MAS	18 MAS	19 MAS	20 MAS	21 MAS
Anai komban	54	64	70	74	82	84	88	90	92	98	96	96	94	90	84	82	70	66	60	46	26	10
	(47.3)	(53.1)	(56.7)	(59.3)	(64.9)	(66.4)	(69.7)	(71.5)	(73.5)	(81.8)	(78.4)	(78.4)	(75.8)	(71.5)	(66.4)	(64.9)	(56.7)	(54.3)	(50.7)	(42.7)	(30.6)	(18.4)
Athur kichili	74	82	90	94	98	98	96	96	96	94	94	94	90	94	86	82	70	66	58	46	0	0
samba	(59.3)	(64.9)	(71.5)	(75.8)	(81.8)	(81.8)	(78.4)	(78.4)	(78.4)	(75.8)	(75.8)	(75.8)	(71.5)	(75.8)	(68.0)	(64.9)	(56.7)	(54.3)	(49.6)	(42.7)	(0.0)	(0.0)
Idly	78	86	90	90	92	92	94	94	96	96	96	96	96	96	96	96	96	90	88	81	68	40
	(62.0)	(68.0)	(71.5)	(71.5)	(73.5)	(73.5)	(75.8)	(75.8)	(78.4)	(78.4)	(78.4)	(78.4)	(78.4)	(78.4)	(78.4)	(78.4)	(78.4)	(71.5)	(69.7)	(64.1)	(55.5)	(39.2)
Illuppaipoo	90	90	92	94	92	94	94	94	94	94	98	96	94	94	90	84	84	78	74	52	36	4
samba	(71.5)	(71.5)	(73.5)	(75.8)	(73.5)	(75.8)	(75.8)	(75.8)	(75.8)	(75.8)	(81.8)	(78.4)	(75.8)	(75.8)	(71.5)	(66.4)	(66.4)	(62.0)	(59.3)	(46.1)	(36.8)	(11.5)
Kalanamak	88	94	98	96	94	94	94	94	92	90	90	88	88	88	86	84	74	72	70	50	0	0
	(69.7)	(75.8)	(81.8)	(78.4)	(75.8)	(75.8)	(75.8)	(75.8)	(73.5)	(71.5)	(71.5)	(69.7)	(69.7)	(69.7)	(68.0)	(66.4)	(59.3)	(58.0)	(56.7)	(45.0)	(0.0)	(0.0)
Karuppukavuni	16	34	38	46	58	60	62	62	70	72	78	82	90	90	94	96	100	96	92	86	82	76
	(23.5)	(35.6)	(38.0)	(42.7)	(49.6)	(50.7)	(51.9)	(51.9)	(56.7)	(58.0)	(62.0)	(64.9)	(71.5)	(71.5)	(75.8)	(78.4)	(89.7)	(78.4)	(73.5)	(68.0)	(64.9)	(60.6)
Kullankar	50	66	80	84	90	90	92	92	96	98	98	98	94	94	90	88	78	74	60	42	0	0
	(45.0)	(54.3)	(63.4)	(66.4)	(71.5)	(71.5)	(73.5)	(73.5)	(78.4)	(81.8)	(81.8)	(81.8)	(75.8)	(75.8)	(71.5)	(69.7)	(62.0)	(59.3)	(50.7)	(40.4)	(0.0)	(0.0)
Kuzhiyadichan	82	90	96	98	98	98	96	94	94	94	94	94	94	94	90	90	84	80	78	76	62	22
	(64.9)	(71.5)	(78.4)	(81.8)	(81.8)	(81.8)	(78.4)	(75.8)	(75.8)	(75.8)	(75.8)	(75.8)	(75.8)	(75.8)	(71.5)	(71.5)	(66.4)	(63.4)	(62.0)	(60.6)	(51.9)	(27.9)
Milagu samba	24	34	44	50	58	64	68	70	84	96	96	98	98	92	88	86	80	54	48	24	0	0
	(29.3)	(35.6)	(41.5)	(45.0)	(49.6)	(53.1)	(55.5)	(56.7)	(66.4)	(78.4)	(78.4)	(81.8)	(81.8)	(73.5)	(69.7)	(68.0)	(63.4)	(47.3)	(43.8)	(29.3)	(0.0)	(0.0)
Mysore malli	94	96	96	96	96	96	100	100	98	98	98	96	96	94	92	90	82	80	60	28	0	0
	(75.8)	(78.4)	(78.4)	(78.4)	(78.4)	(78.4)	(89.7)	(89.7)	(81.8)	(81.8)	(81.8)	(78.4)	(78.4)	(75.8)	(73.5)	(71.5)	(64.9)	(63.4)	(50.7)	(31.9)	(0.0)	(0.0)
Navara	74	78	86	90	96	96	96	98	98	100	98	98	98	98	98	98	94	90	86	74	62	10
	(59.3)	(62.0)	(68.0)	(71.5)	(78.4)	(78.4)	(78.4)	(81.8)	(81.8)	(89.7)	(81.8)	(81.8)	(81.8)	(81.8)	(81.8)	(81.8)	(75.8)	(71.5)	(68.0)	(59.3)	(51.9)	(18.4)
Norungan	88	90	92	94	96	96	96	96	96	96	96	98	96	96	94	94	92	90	74	34	0	0
	(69.7)	(71.5)	(73.5)	(75.8)	(78.4)	(78.4)	(78.4)	(78.4)	(78.4)	(78.4)	(78.4)	(81.8)	(78.4)	(78.4)	(75.8)	(75.8)	(73.5)	(71.5)	(59.3)	(35.7)	(0.0)	(0.0)
Poovan samba	82	82	86	88	90	90	90	90	92	94	98	96	94	94	93	90	84	78	54	26	0	0
	(64.9)	(64.9)	(68.0)	(69.7)	(71.5)	(71.5)	(71.5)	(71.5)	(73.5)	(75.8)	(81.8)	(78.4)	(75.8)	(75.8)	(74.6)	(71.5)	(66.4)	(62.0)	(47.3)	(30.6)	(0.0)	(0.0)
Samba mosanum	76	86	90	90	92	92	94	94	96	100	98	96	94	90	86	84	74	72	64	52	20	0
	(60.6)	(68.0)	(71.5)	(71.5)	(73.5)	(73.5)	(75.8)	(75.8)	(78.4)	(89.7)	(81.8)	(78.4)	(75.8)	(71.5)	(68.0)	(66.4)	(59.3)	(58.0)	(53.1)	(46.1)	(26.5)	(0.0)
Seeraga samba	86	88	90	90	92	92	94	94	96	98	96	94	94	90	90	88	78	78	66	46	32	12
	(68.0)	(69.7)	(71.5)	(71.5)	(73.5)	(73.5)	(75.8)	(75.8)	(78.4)	(81.8)	(78.4)	(75.8)	(75.8)	(71.5)	(71.5)	(69.7)	(62.0)	(62.0)	(54.3)	(42.7)	(34.4)	(20.2)
Sorna masuri	64	66	72	82	86	88	92	92	94	96	96	96	94	82	80	78	70	62	54	34	6	6
	(53.1)	(54.3)	(58.0)	(64.9)	(68.0)	(69.7)	(73.5)	(73.5)	(75.8)	(78.4)	(78.4)	(78.4)	(75.8)	(64.9)	(63.4)	(62.0)	(56.7)	(51.9)	(47.3)	(35.7)	(14.1)	(14.1)
Thulasi vasanai	86	90	92	98	96	96	94	92	88	88	86	82	78	78	76	68	68	62	50	22	0 (0.0)	0
	(68.0)	(71.5)	(73.5)	(81.8)	(78.4)	(78.4)	(75.8)	(73.5)	(69.7)	(69.7)	(68.0)	(64.9)	(62.0)	(62.0)	(60.6)	(55.5)	(55.5)	(51.9)	(45.0)	(27.9)		(0.0)
Mean	71	78	83	86	89	90	91	91	92	94	94	94	93	91	89	87	81	76	66	48	23	11
	(57.4)	(62.0)	(65.6)	(68.0)	(70.6)	(71.5)	(72.5)	(72.5)	(73.5)	(75.8)	(75.8)	(75.8)	(74.6)	(72.5)	(70.6)	(68.8)	(64.1)	(60.6)	(54.3)	(43.8)	(28.6)	(19.3)
	Varieties (V)						Storage period (S)								V×S							
SEd	0.73						0.81								3.44							
CD (P=0.05)	1.44						1.59								6.77							

Values in parenthesis indicates arcsine transformed values.

Table 2. Effect of seed storage on vigour index in rice landraces.

Varieties	Vigour index																					
	Initial	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	7 MAS	8 MAS	9 MAS	10 MAS	11 MAS	12 MAS	13 MAS	14 MAS	15 MAS	16 MAS	17 MAS	18 MAS	19 MAS	20 MAS	21 MAS
Anaikomban	1411	1715	1919	2053	2283	2359	2502	2553	2653	2992	2977	3130	3374	3426	2811	2619	2005	1696	1452	1028	475	181
Athur kichili samba	1658	1919	2147	2255	2357	2421	2322	2372	2414	2372	2576	2678	2619	2751	2476	1996	1672	1508	1256	867	0	0
Idly	2204	2471	2592	2595	2708	2781	2907	2880	3145	3211	3373	3440	3607	3759	3533	3422	3428	3463	3229	2689	1709	809
Illuppaipoo samba	2187	2477	2603	2592	2589	2575	2673	2680	2862	2926	2902	2623	2533	2479	2511	2206	2268	2070	1950	1122	623	64
Kalanamak	1906	2190	2377	2462	2443	2468	2397	2374	2456	2305	2704	2530	3406	3318	2976	2325	1794	1707	1596	1054	0	0
Karuppukavuni	393	852	994	1230	1587	1688	1774	1689	1994	2161	2441	2764	3010	2964	3196	3422	3751	3590	3280	2786	2225	1872
Kullankar	1274	1744	2252	2439	2665	2759	2838	2939	3288	3518	3394	3438	3130	2942	2732	2640	2200	1980	1309	728	0	0
Kuzhiyadichan	2229	2516	2698	2871	2970	3009	2914	2818	2670	2659	2664	2710	2581	2524	2262	2270	2090	1964	1866	1749	1335	404
Milagu samba	595	856	1121	1270	1505	1677	1865	2020	2501	3043	3130	3352	3363	2907	2693	2073	1836	1185	908	364	0	0
Mysore malli	2814	2995	3024	3102	3072	3102	3146	3112	3077	2982	2952	2801	2731	2585	2479	2423	1951	1784	1180	398	0	0
Navara	1615	1740	2070	2213	2412	2458	2704	2813	2876	2940	2945	2852	2774	2774	2477	2444	2343	2231	2041	1666	1325	195
Norungan	2422	2542	2645	2820	3110	3145	3121	2991	2993	3069	2989	2868	2774	2702	2571	2543	2433	2173	1694	696	0	0
Poovan samba	2342	2349	2485	2543	2641	2571	2601	2790	2995	3130	3308	3216	3054	2641	2065	1958	1798	1598	975	382	0	0
Samba mosanum	2096	2550	2741	2675	2757	2650	2631	2602	3053	3065	2994	2924	2838	2670	2402	2257	1713	1546	1328	1043	304	0
Seeraga samba	1767	1924	2022	2061	2136	2181	2117	2053	2194	2192	2184	2301	2279	2141	2173	2219	1860	1802	1469	858	356	145
Sorna masuri	1490	1554	1757	2070	2249	2397	2566	2620	2725	3055	2928	2850	2703	2295	2184	2001	1691	1406	1137	615	84	79
Thulasi vasanai	2087	2249	2390	2612	2616	2380	2237	2047	1910	1747	2051	1918	1778	2241	2073	1596	1356	1166	910	311	0	0
Mean	1817	2067	2253	2364	2481	2500	2542	2547	2681	2769	2845	2838	2850	2761	2552	2363	2112	1919	1605	1072	495	217
	Varieties (V)							Storage period (S)								V×S						
SEd	19.87							21.97								93.23						
CD (P=0.05)	39.08							43.20								183.30						

Kalanamak, Seeraga samba, Kullankar, Athur kichili samba, Mysore malli, Sorna masuri, Kuzhiyadichan, Anaikomban, Norungan, Milagu samba and Poovan samba have maintained their germination of above 80 % upto 14 to 17 months (Table 1). However, seeds of the variety Thulasi vasanai exhibited a declining trend in germination from the ninth month onwards and maintained their minimum standards of germination for up to 11 months (82%) only. Remarkably, certain varieties performed well in storage such as Idly (88%), Navara (86%) and Karuppu kavuni (92%) which showed maximal germination after 18 months of storage under ambient conditions. Among these three, Karuppu kavuni maintained 82 % germination up to 20 months.

The vigour index of the traditional rice varieties gets reduced with the increase in storage period. Initially, the vigour index was lesser due to the presence of dormancy in the seeds which leads to poor germination and seedling growth. Subsequently, the vigour index increases with the advancement of the storage period and after a certain period of storage, it starts declining due to the reduction in seed germination and seedling length (Table 2). This might be owing to the deterioration of seeds and loss of enzyme activities in the seeds. The deterioration leads to loss of cellular integrity and leaching out of the metabolites present in the seed.

It is concluded that the landraces *viz*., Karuppu kavuni, Idly and Navara have remarkably performed well in storage which exhibited minimum standards of germination (80%) upto 18 months under ambient storage conditions. Therefore, these good storer varieties can be used in the breeding programme for further development of new varieties with better storability.

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(Manuscript received on 30 November, 2024; revised on 27 February, 2025)