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Influence of Temperature of Production Environment on Seed Quality and Storability of Rice Genotypes

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A B S T R A C T

Food production to meet the demand of future population is solely dependent on cereal grain production, especially rice. High temperature stress is one of the stresses which adversely affect crop production. Being grown in narrow temperature range, a slight increase in the temperature will drastically reduce the yield of rice. Quality seed assures 20-25% increase in yield. Hence, the present investigation was carried out to find the storability of the paddy seed raised under higher temperature by raising five rice varieties *viz.*, MDU 5, ASD 16, CO 51, Anna (R) 4 and ADT 43 in field condition at Coimbatore under two temperature regimes-high (summer, 2016) and normal (*rabi*, 2016) temperature in field condition and the resultant seeds were harvested and stored in ambient condition in cloth bag. Speed of germination was significantly lower at higher temperature (6.83) than normal temperature (7.84). Germination percentage also recorded significant differences for temperature, varieties and interaction between temperature-variety and variety-storage period. Higher temperature had significantly lower germination (92%) than normal temperature (88%). Temperature regime, varietal differences and interactional effects influenced the vigour index also. Electrical conductivity gradually decreased with the increase in period of storage. As the temperature increased the dehydrogenase activity was found to be decreased (0.389 from 0.541) and alpha amylase activity from.

Introduction

Rice (*Oryza sativa* L.) is the single most important food crop in terms of direct human food consumption which is cultivated under a wide range of environments, many of which are experiencing increases in daytime and night time temperatures. Asian rice consumption is projected to account for 67 per cent of the total increase, rising from 388 million tons in 2010 to 465 million tons in 2035 despite a continuing decline in per capita consumption in China and India. A basket of emerging problems in agriculture has narrowed down the smooth pursuance of enhanced productivity. Among these, the burning issue of climate change and its possible consequences on agricultural production has received importance late, but the problem is very real. Rice grain production drops 10% for each 1 °C increase in minimum growing season temperature (Peng *et al.,* 2004). The unfavourable influence of high temperature (HT) on cereal crop yields results from the negative impact on development of morphological units that contribute to harvest index (HI), and responses vary with the timing, duration, and severity of the heat stress (Barnabas *et al.*, 2008). The ill effects do not stop with the yield and harvest index, it stretches up to seed quality. Seeds deteriorate during storage. This aging is manifested as a reduction in percentage germination, while those seeds that do germinate, produce weak seedlings. During the aging process, seeds lose their vigour, ability to germinate and ultimately become less viable (Maity *et al.*, 2000). It is assumed that as the production environment changes the spectrum and type of infection by the pathogens tend to change which ultimately causes severe losses during storage and also reduces the seed quality. Losses in seed quality during storage are exacerbated if seeds are obtained from parent plants exposed to high temperature environment. There is paucity of literature on the storability of the resultant seeds from parent plant raised at higher temperatures. At this backdrop, considering the relevance to explore the effects of high temperature stress on seed storability, the present investigation was taken up with the objective to study the storability of the paddy seed raised under higher temperature and normal temperature.

Materials and Methods

Genetically pure seeds of rice varieties MDU 5, ASD 16, CO 51, Anna (R) 4 and ADT 43 obtained from the Department of Rice, Tamil Nadu Agricultural University, Coimbatore were used for sowing at Coimbatore during summer, 2016 and during *rabi*, 2016. The average maximum air temperature at flowering during summer, 2016 was 37° C and that during *rabi*, 2016 was 32° C. Seeds were harvested at physiological maturity stage. Harvested seeds of different varieties were dried, packed in cloth bag and stored under ambient conditions for a period of 12 months. The experiment was designed in Factorial Completely Randomized Design (FCRD) with four replications. Seed samples were drawn at bimonthly interval for seed quality analysis.

Speed of germination

Four replicates of twenty five seeds each were used to test the speed of germination of seeds from different treatments. The seeds showing radicle protrusion were counted daily from second day after sowing until fourteenth day. Speed of germination was calculated using the following formula and the results were expressed in number (Maguire, 1962).

$$\text{Speed of germination} = \frac{X_1}{Y_1} + \frac{X_2 - X_1}{Y_2} + \text{..........} + \frac{X_n - X_{n-1}}{Y_n}$$

X_1- Number of seeds germinated at first count, X_2- Number of seeds germinated at second count, X_n- Number of seeds germinated on n^{th} day, Y_1- Number of days from sowing to first count, Y_2- Number of days from sowing to second count, Y_n- Number of days from sowing to n^{th} count.

Germination

The germination test was conducted by following the procedure outlined in ISTA (1999) using paper (between papers) medium.

Four replicates of 100 seeds each were germinated in a germination room maintained at 25±2°C temperature and 90±3% RH. Number of normal seedlings was counted and expressed in percentage at the end of fourteenth day of sowing.

Vigour index

Vigour index values were computed using the following formulae of Abdul-Baki and Anderson, 1973. Vigour index I = Germination (%) x Seedling length (cm)

Electrical conductivity

Four replicates of twenty five seeds each were prewashed well with distilled water to remove the adhering chemicals and then soaked in 25 ml of distilled water for 15 h at room temperature. The electrical conductivity of the seed leachate was measured in a digital conductivity meter with a cell constant of one and expressed as μSm^{-1} (Presley, 1958).

Dehydrogenase activity

For estimating the dehydrogenase activity, 0.5% 2, 3, 5-triphenyl tetrazolium chloride solution was dissolved in Sorenson's buffer. Representative seeds from each treatment were taken and preconditioned by soaking in water for 7 h. Seeds were bisected longitudinally into two halves, one half with embryo was steeped in tetrazolium solution and kept in dark for 2h at 40°C for staining. After staining, the excess solution was drained and the seeds were washed thoroughly with distilled water and transferred to a test tube containing 10 ml of 2-methoxy ethanol (methyl cellosolve). The test tube was allowed to remain in the incubator in darkness overnight for extracting the red colour formazon. The coloured solution was decanted and the colour intensity was measured in an ELICO UV-VIS spectrophotometer (Model SP- 2205) using blue filter (470 nm) and methyl cellosolve as the blank. The OD value obtained was reported as dehydrogenase activity (Kittock and Law, 1968).

α-amylase enzyme activity

Accurately 500 mg of pre germinated seed samples were homogenised in 1.8 ml of cold 0.02M sodium phosphate buffer (pH 6.0) and centrifuged at 20,000 rpm for 20 min. to extract enzymes. To 0.1 ml of enzyme extract, one ml 0.067 per cent starch solution was added. The reaction was stopped after 10 min. of incubation at 25°C by the addition of one ml of iodine HCl solution (60 mg KI and 6 mg I_2 in 100 ml of 0.05N HCl). Change in colour was measured at 620 nm. The activity was calculated and expressed as mg maltose min^{-1} (Paul *et al.*, 1970).

$$\alpha\text{- amylase enzyme activity} = \frac{\text{OD value}}{\text{Volume of sample pipetted out}} \times \frac{1000}{500}$$

Results and Discussion

Speed of germination was significantly influenced by temperature, varieties and their interactional effect. Speed of germination was significantly lower at higher temperature (6.83) than normal temperature (7.84). The speed of germination tends to increase in the second month (7.49) when compared to initial (5.88) and there after it decreased (Table 1). Germination percentage also recorded significant differences for temperature, varieties and interaction between temperature-variety and variety-storage period. Higher temperature had significantly lower germination (92%) than normal temperature (88%). There was an increase in germination per cent in the second month (95%) from the germination per cent of first month (88%). Thereafter, the germination percentage seems to decrease gradually as the storage period progressed. The varieties ASD 16 and Anna (R) 4 recorded significantly higher germination percentage (91%) than other varieties (Table 2). Temperature regime, varietal differences and interactional effects influenced the vigour index. A vigour index of 2327 was recorded at higher temperature when compared to vigour index of 2709, which varied significantly. Highest interactional effect was seen in Anna (R) 4 variety grown in normal temperature (Table 3). The vigour index up to six months was significantly higher than the initial vigour index and it gradually decreased as the storage period continued. Interactional effects were not significant for electrical conductivity but were significant for temperature, varieties and period of storage. Electrical conductivity at higher temperature was 128.2 and that of normal temperature was only 102.3. Anna (R) 4 recorded the highest membrane stability compared to other varieties. Electrical conductivity gradually decreased with the increase in period of storage (Table 4). As the temperature increased the dehydrogenase activity also decreased (0.389 from 0.541). Dehydrogenase activity was significantly higher in the second month of storage compared to initial dehydrogenase activity. The dehydrogenase activity of third month was on par with that of beginning of storage. Among the interactional effect, significantly higher dehydrogenase activity was seen in Anna (R) 4 from normal temperature regime (Table 5). Alpha amylase activity was found to be significantly influenced by temperature, varieties, period of storage and their interactions. There was a significant reduction in alpha amylase activity at higher temperature (1.81) than normal temperature (2.02). Anna (R) 4 recorded significantly higher amylase activity (2.04) than other varieties and lowest amylase activity was recorded in CO 51 (1.82). With the advance in storage, the amylase activity increased from initial after 2 months of storage (2.06) and there after decreased gradually and finally recorded a significantly lower value of 1.79 after 12 months of storage (Table 6).

Seed quality is an important trait required to ensure uniform crop stand and higher productivity. From the present investigation it is evident that the seed quality measured in terms of seed moisture, seed germination and seed vigour (speed of germination, seedling vigour index, electrical conductivity and dehydrogenase activity) is affected by temperature stress of the production environment. When the resultant seeds from temperature stress environments are kept for storage the rate of deterioration is even faster. Deterioration of seed quality is associated with moisture content during storage (Ramanadane and Ponnuswamy, 2004). In the present study, moisture content was seen fluctuating with advance of storage period irrespective of varieties under natural ageing. The increase in moisture content might be due to the increase in relative humidity of the storage environment and also differential behavior of the genotypes in absorbing the moisture during natural ageing. This result was in agreement with Bhaskaran (1995) in rice, Bharathi (1991) in maize and Sawant *et al.,* (2012) in wheat which showed increasing trend of moisture content with respect to the storage period.

Speed of germination, germination percentage and seedling vigour was observed to increase in the second month of storage compared to the initial month and it can be attributed to the presence of seed dormancy in the varieties. It is evident that the seed dormancy is broken within two months. The concurrent results were obtained by Verma *et al.,* (1990). They reported positive correlation of germination percentage with that of root length and vigour index. Deshpande and Mahadevappa (1994) observed that in rice, germinability and seedling vigour decreased as the ageing and storage period prolonged. Atici *et al.,* (2007) reported that aged seeds show decreased vigour and produce weak seedlings that are unable to survive once reintroduced into a habitat.

In the seeds obtained from normal and higher temperature regime, the electrical conductivity was found to increase with the advancement in the storage period. This might be due to increase of moisture content that might have promoted the metabolic process resulting in leaching of free sugars and free amino acids.

Table.1 Influence of period of storage on speed of germination of result rice seeds from normal and higher temperature

Temperature	Variety (V)	Period of storage (months) (M)							
		0	2	4	6	8	10	12	Mean
T1	V1	6.30	7.21	7.15	7.09	6.95	6.88	6.81	**6.91**
	V2	6.36	7.45	7.4	7.37	7.33	7.24	7.18	**7.19**
	V3	8.13	9.67	9.61	9.55	9.50	9.44	9.37	**9.32**
	V4	8.11	9.22	9.17	9.13	9.07	8.98	8.91	**8.94**
	V5	6.01	7.13	7.06	6.98	6.93	6.87	6.81	**6.83**
	Mean	**6.98**	**8.14**	**8.08**	**8.02**	**7.96**	**7.882**	**7.82**	**7.84**
T2	V1	4.40	7.15	6.98	6.50	6.10	5.70	5.40	**6.03**
	V2	4.85	7.24	7.17	6.80	6.80	6.10	5.70	**6.38**
	V3	4.52	5.89	5.83	5.10	4.70	4.10	3.80	**4.85**
	V4	7.03	7.92	7.83	7.20	6.50	6.20	5.80	**6.93**
	V5	3.08	6.03	5.93	5.50	5.10	4.70	4.40	**4.96**
	Mean	**4.78**	**6.85**	**6.748**	**6.22**	**5.84**	**5.36**	**5.02**	**5.83**
Grand Mean		**5.88**	**7.49**	**7.41**	**7.12**	**6.89**	**6.62**	**6.42**	**6.83**

	T1	T2	V1	V2	V3	V4	V5
Mean	7.84	5.83	6.47	6.79	7.09	7.93	5.89
	T	**V**	**M**	**TV**	**VM**	**TM**	**TVM**
SEd	0.02	0.03	0.03	0.04	0.07	0.05	0.10
CD (P=0.05)	0.03	0.05	0.06	0.08	0.14	0.09	0.20

Figures in parenthesis are arc sine transformed values
T1- Normal Temperature T2- Higher Temperature
V1-MDU 5 V2-ASD 16 V3-CO 51 V4-Anna (R) 4 V5-ADT 43

Table.2 Influence of period of storage on germination per cent (%) of resultant seeds from normal and higher temperature

Temperature	Variety (V)	Period of storage (months) (M)							
		0	2	4	6	8	10	12	Mean
T1	V1	86(68.03)	96(78.47)	94(75.82)	92(73.57)	91(72.54)	89(70.63)	86(68.03)	**91(72.54)**
	V2	92(73.57)	97(80.03)	95(77.08)	94(75.82)	92(73.57)	90(71.57)	87(68.87)	**92(73.57)**
	V3	93(74.66)	98(81.87)	95(77.08)	93(74.66)	91(72.54)	90(71.57)	87(68.87)	**92(73.57)**
	V4	94(75.82)	98(81.87)	96(78.47)	94(75.82)	92(73.57)	90(71.57)	88(69.73)	**93(74.66)**
	V5	86(68.03)	93(74.66)	92(73.57)	90(71.57)	89(70.63)	88(69.73)	85(67.22)	**89(70.63)**
	Mean	**90(71.57)**	**96(78.47)**	**94(75.82)**	**93(74.66)**	**91(72.54)**	**90(71.57)**	**87(68.87)**	**92(73.57)**
T2	V1	76(60.67)	95(77.08)	93(74.66)	89(70.63)	89(70.63)	88(69.73)	80(63.44)	**87(68.87)**
	V2	88(69.73)	93(74.66)	91(72.54)	90(71.57)	88(69.73)	88(69.73)	82(64.89)	**89(70.63)**
	V3	90(71.57)	93(74.66)	90(71.57)	87(68.87)	86(68.03)	85(67.22)	80(63.44)	**87(68.87)**
	V4	90(71.57)	94(75.82)	92(73.57)	91(72.54)	88(69.73)	86(68.03)	82(64.89)	**89(70.63)**
	V5	86(68.03)	93(74.66)	90(71.57)	89(70.63)	86(68.029)	85(67.22)	80(63.44)	**87(68.87)**
	Mean	**86(68.03)**	**94(75.82)**	**91(72.54)**	**89(70.63)**	**87(68.87)**	**86(68.03)**	**81(64.16)**	**88(69.73)**
Grand Mean		**88(69.73)**	**95(77.08)**	**93(74.66)**	**91(72.54)**	**89(70.63)**	**88(69.73)**	**84(66.42)**	**90(71.57)**

	T1	T2	V1	V2	V3	V4	V5
Mean	**92**(73.57)	**88(69.73)**	89(70.63)	91(72.54)	90(71.57)	91(72.54)	**88**(69.73)
	T	**V**	**M**	**TV**	**VM**	**TM**	**TVM**
SEd	0.22	0.35	0.41	0.49	0.92	0.58	1.29
CD (P=0.05)	0.43	0.68	0.809	0.96	1.81	NS	NS

Figures in parenthesis are arc sine transformed values
T1- Normal Temperature T2- Higher Temperature
V1-MDU 5 V2-ASD 16 V3-CO 51 V4-Anna (R) 4 V5-ADT 43

Table.3 Influence of period of storage on seedling vigour index of resultant seeds from normal and higher temperature

Temperature	Variety (V)	Period of storage (months) (M)							
		0	2	4	6	8	10	12	Mean
T1	V1	2599	3010	2868	2723	2620	2512	2374	**2672**
	V2	2907	3156	3049	2924	2813	2699	2574	**2875**
	V3	2419	2673	2498	2364	2252	2175	2077	**2351**
	V4	3122	3380	3207	3069	2933	2790	2675	**3025**
	V5	2547	2928	2808	2685	2581	2473	2322	**2621**
	Mean	**2719**	**3029**	**2886**	**2753**	**2640**	**2530**	**2404**	**2709**
T2	V1	2104	2680	2553	2408	2364	2301	2066	**2354**
	V2	2586	2771	2635	2583	2488	2454	2250	**2538**
	V3	2058	2143	2031	1931	1892	1840	1716	**1944**
	V4	2652	2810	2685	2615	2509	2424	2278	**2568**
	V5	2282	2498	2346	2280	2164	2091	1952	**2230**
	Mean	**2336**	**2580**	**2450**	**2364**	**2283**	**2222**	**2052**	**2327**
Grand Mean		**2527**	**2804**	**2668**	**2558**	**2461**	**2375**	**2228**	**2518**

	T1	T2	V1	V2	V3	V4	V5
Mean	2709	2327	2512	2706	2147	2796	2425
	T	**V**	**M**	**TV**	**VM**	**TM**	**TVM**
SEd	7.27	11.49	13.60	16.26	30.42	19.24	43.02
CD (P=0.05)	14.34	22.67	26.82	32.06	59.97	37.93	84.82

T1- Normal Temperature T2- Higher Temperature
V1-MDU 5 V2-ASD 16 V3-CO 51 V4-Anna (R) 4 V5-ADT 43

Table.4 Influence of period of storage on electrical conductivity (dSm^{-1}) of resultant seeds from normal and higher temperature

Temperature	Variety (V)	Period of storage (months) (M)							
		0	**2**	**4**	**6**	**8**	**10**	**12**	**Mean**
T1	**V1**	65.0	89.0	114.0	121.0	129.0	136.0	144.0	**114.0**
	V2	61.0	81.0	103.0	111.0	123.0	130.0	141.0	**107.1**
	V3	49.0	62.0	76.0	85.0	93.0	103.0	115.0	**83.3**
	V4	50.0	64.0	79.0	88.0	97.0	108.0	119.0	**86.4**
	V5	71.0	95.0	123.0	129.0	133.0	141.0	152.0	**120.6**
	Mean	**59.2**	**78.2**	**99.0**	**106.8**	**115.0**	**123.6**	**134.2**	**102.3**
T2	**V1**	78.0	96.0	128.0	133.0	141.0	151.0	167.0	**127.7**
	V2	72.0	93.0	116.0	124.0	132.0	143.0	157.0	**119.6**
	V3	93.0	117.0	144.0	151.0	166.0	176.0	189.0	**148.0**
	V4	62.0	75.0	108.0	118.0	131.0	146.0	158.0	**114.0**
	V5	84.0	110.0	128.0	135.0	142.0	156.0	166.0	**131.6**
	Mean	**77.8**	**98.2**	**124.8**	**132.2**	**142.4**	**154.4**	**167.4**	**128.2**
Grand Mean		**68.5**	**88.2**	**111.9**	**119.5**	**128.7**	**138.9**	**150.8**	**115.2**

	T1	**T2**	**V1**	**V2**	**V3**	**V4**	**V5**
Mean	102.3	128.2	120.9	113.4	115.6	100.2	126.1
	T	**V**	**M**	**TV**	**VM**	**TM**	**TVM**
SEd	0.29	0.45	0.53	0.64	1.19	0.76	1.69
CD (P=0.05)	0.56	0.89	1.05	1.26	2.36	1.49	3.33

T1- Normal Temperature   T2- Higher Temperature
V1-MDU 5   V2-ASD 16   V3-CO 51   V4-Anna (R) 4   V5-ADT 43

Table.5 Influence of period of storage on dehydrogenase activity (OD value) of resultant seeds from normal and higher temperature

Temperature	Variety (V)	Period of storage (months) (M)							
		0	2	4	6	8	10	12	Mean
T1	V1	0.482	0.489	0.481	0.475	0.467	0.455	0.443	**0.470**
	V2	0.503	0.523	0.517	0.509	0.498	0.489	0.477	**0.502**
	V3	0.680	0.686	0.679	0.666	0.654	0.643	0.637	**0.664**
	V4	0.689	0.693	0.685	0.677	0.667	0.658	0.647	**0.674**
	V5	0.366	0.421	0.416	0.409	0.397	0.387	0.379	**0.396**
	Mean	**0.544**	**0.562**	**0.556**	**0.547**	**0.537**	**0.526**	**0.517**	**0.541**
T2	V1	0.470	0.475	0.463	0.411	0.398	0.393	0.387	**0.428**
	V2	0.493	0.518	0.487	0.455	0.447	0.443	0.440	**0.469**
	V3	0.133	0.136	0.132	0.127	0.124	0.118	0.115	**0.126**
	V4	0.641	0.663	0.612	0.597	0.586	0.582	0.579	**0.609**
	V5	0.344	0.360	0.322	0.301	0.298	0.294	0.290	**0.316**
	Mean	**0.416**	**0.430**	**0.403**	**0.378**	**0.371**	**0.366**	**0.362**	**0.389**
Grand Mean		**0.479**	**0.496**	**0.479**	**0.463**	**0.454**	**0.446**	**0.4394**	**0.465**

	T1	T2	V1	V2	V3	V4	V5
Mean	0.541	0.389	0.449	0.486	0.395	0.641	0.356
	T	**V**	**M**	**TV**	**VM**	**TM**	**TVM**
SEd	0.001	0.002	0.002	0.003	0.005	0.003	0.007
CD (P=0.05)	0.002	0.004	0.004	0.005	0.009	0.006	0.013

T1- Normal Temperature T2- Higher Temperature
V1-MDU 5 V2-ASD 16 V3-CO 51 V4-Anna (R) 4 V5-ADT 43

Table.6 Influence of period of storage on α-amylase activity (mg maltose min^{-1}) of resultant seeds from normal and higher temperature

Temperature	Variety (V)	Period of storage (months) (M)							
		0	2	4	6	8	10	12	Mean
T1	V1	2.05	2.06	2.02	1.97	1.94	1.90	1.86	**1.97**
	V2	2.09	2.11	2.08	2.03	1.99	1.96	1.93	**2.03**
	V3	2.11	2.16	2.12	2.08	2.03	1.99	1.96	**2.06**
	V4	2.14	2.18	2.14	2.11	2.07	2.03	1.99	**2.09**
	V5	1.98	2.05	2.01	1.97	1.94	1.90	1.85	**1.96**
	Mean	**2.07**	**2.11**	**2.07**	**2.03**	**1.99**	**1.96**	**1.92**	**2.02**
T2	V1	1.89	2.02	1.98	1.86	1.81	1.77	1.73	**1.87**
	V2	1.98	2.05	2.00	1.91	1.85	1.81	1.76	**1.91**
	V3	1.62	1.83	1.66	1.57	1.49	1.45	1.39	**1.57**
	V4	2.02	2.13	2.09	1.98	1.93	1.88	1.84	**1.98**
	V5	1.77	1.99	1.79	1.67	1.61	1.57	1.54	**1.71**
	Mean	**1.86**	**2.00**	**1.90**	**1.80**	**1.74**	**1.70**	**1.65**	**1.81**
Grand Mean		**1.96**	**2.06**	**1.99**	**1.92**	**1.87**	**1.83**	**1.79**	**1.91**

	T1	T2	V1	V2	V3	V4	V5
Mean	2.02	1.81	1.92	1.97	1.82	2.04	1.83
	T	**V**	**M**	**TV**	**VM**	**TM**	**TVM**
SEd	0.004	0.007	0.008	0.009	0.018	0.011	0.025
CD (P=0.05)	0.008	0.013	0.016	0.019	0.035	0.022	0.049

T1- Normal Temperature T2- Higher Temperature
V1-MDU 5 V2-ASD 16 V3-CO 51 V4-Anna (R) 4 V5-ADT 43

Electrical conductivity gives the status of membrane stability. Once the membrane stability is compromised, deterioration is enhanced. Abdul-Baki and Anderson (1970) observed that leaching of sugars increased with increase in seed age and increased injury to endosperm resulting in reduction in seed quality. Aswathaiah and Sadasivamurthy (1986) observed lower vigour and higher electrical conductivity of sorghum seed leachate with increase in the storage period. Dey and Basu (1982) observed a sharp fall in dehydrogenase activity with increase in ageing period in sunflower seeds. Direct correlation was established between germinability and dehydrogenase activity. Dey and Mukherjee (1986) observed greater activity of dehydrogenase and peroxidase throughout storage.

Rame Gowda (1992) observed rapid decrease in protein content, alpha amylase, total dehydrogenase, peroxidase, total nucleic acids and RNA content and increase in electrical conductivity, total soluble sugars, free aminoacids, melanoldehyde (MDH) a product of lipid peroxidation during ageing and these are related to loss of germinability and seedling vigour of rice seeds. So, the changes in electrical conductivity and dehydrogenase activity can be correlated with the loss of germination and seedling vigour of the seeds during storage. The initial quality of the seed is also a prime factor determining the period of storability. As the seeds from higher temperature were found to be lower in the initial seed quality the storability was also found to be lower in those seeds. α-amylase actually represents the predominant contribution of the carbohydrate metabolism in endosperm of rice seeds and represents the variable spectrum of germination potential (seed vigour) of sindh rice cultivars (Galani *et al.*, 2011). α-amylase activity is a biochemical indicator showing different germination abilities of rice varieties, leading to different seed vigour. From the present investigation it can be concluded that the storability of the seeds is influenced by the production environment. The temperature stress experienced by the mother plant will have negative impact on the seed quality and storability of the resultant seeds.

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