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Shelf Life of Hybrid Rice (CORH-2) Seed as Influenced by Stage of Harvest

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ABSTRACT An experiment was conducted at the department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, India, to know the effect of stage of harvest on storability of rice hybrid CORH-2. The results revealed that the seeds harvested at early stages of 20 and 25 days after 50 per cent flowering lost their viability quickly while, the seeds harvested at 30 and 35 days after 50 per cent flowering retained their viability over a period of 10 months. These results indicated that the seeds (F_1) of rice hybrid CORH 2 harvested at 30-35 days after 50 per cent flowering could be stored for a period of 10 months with minimum loss of vigour and viability as compared to the seeds harvested before 30 and after 35 days after 50 per cent flowering.

Key words : Rice hybrid, storability

One of the important factors that affect the production of good quality seeds and its subsequent performance is the maturity stage at which the crop is harvested, which is prone to modifications by environment and agronomic practices [1]. Harvesting of seed crop at earlier than physiological maturity and delayed harvest may result in variation in yield, seed losses and may adversely affect the seed quality in storage. The maintenance of quality during storage depends upon the pre - history of seed. Delaying the harvest after maturation is the same as storing seeds in the field which contributes considerably to seed deterioration [2]. The over matured seeds will be subjected to varied weather conditions, which may cause decline in seed viability and vigour [3]. Keeping this in view, an experiment was conducted to elicit the information of the stage harvest on seed quality of hybrid rice under storage.

MATERIAL AND METHODS

The hybrid seed (certified seed) production of rice hybrid CORH-2 was undertaken at wet land farm, Tamil Nadu Agricultural University, Coimbatore, India. Bulk crop was raised during rabi 2001 by following the standard package of practices [4]. The crop was harvested starting 20 days after 50 per cent flowering (115 DAS) at an interval of 5 days. The seeds collected from each harvest stage were dried to safe moisture content of 12 per cent. Thereafter, the seeds were treated invariably with halogen mixture + thiram @3g kg^{-1} of seeds and stored in cloth bag under ambient conditions upto 10 months. Required quantity of seed sample was drawn at bimonthly interval for evaluating the seed germination [5] vigour [6], electrical conductivity [7], protein content [8], starch content [9], free amino acids [10], free suagars, total sugars [9], dehydrogenase [11], alpha amylase [12], ATP ase activity [13], catalase [14] and peroxidase enzyme activity. The statistical analysis was done by following the procedure of Panse and Sukhatme [15]

RESULT AND DISCUSSION

Seed quality, in its broader outlook, includes the storage potential of well filled seeds. Seed crop

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agronomic practices like harvesting stages decide the storage potential of resultant seeds [16]. The seed crop harvested at 30 days after pollination could be stored upto 8 months under ambient conditions safely. The present study revealed that the maximum decrease in germination (Fig. 1), root and shoot length (Table 2), dry matter production (Table 3) and vigour index (Fig. 1) obtained with the seeds harvested at early stages of 20 and 25 days after 50 per cent flowering over a period of 10 months and was minimum in seeds harvested at 30 and 35 days after 50 per cent flowering. Irrespective of stages of harvest, all the above mentioned physiological seed qualities were decreased with increase in period of storage. The decrease in seed quality during storage of seeds harvested before 30 days after 50 per cent flowering might be due to their immature and partial filling and improper embryo differentiation [3]. This could also be attributed to increase in electrical conductivity and decrease in sugars, protein and enzyme activity of seeds during storage. The retention of these seed quality attributes in seeds harvested at 30 days after 50 per cent flowering during storage might be due to initial vigour potential of seeds.

As the storage period increased the electrical conductivity (Table 4), free sugars and free amino acids content (Table 8) of seed leachate also increased. The increase was higher in seeds harvested at early stages of 20 and 25 days after 50 per cent flowering than the seeds harvested at 30 and 35 days after 50 per cent flowering over a period of 10 months. The relatively high electrical conductivity of the seed leachate of early harvested seeds under storage could be ascribed to the leaching of sugars and amino acids in greater amount owing to their high

Table 1. Influence of stage of harvest on seed moisture content and germination in rice hybrid CORH2 during storage

Stage of harvest (Days after 50% flowering)	Germination (%)						
	P_0	P_2	P_4	P_6	P_8	P_{10}	D Mean
20	38 (38.05)	34 (35.66)	27 (31.30)	24 (29.32)	18 (25.08)	15 (22.75)	26 (30.36)
25	80 (63.45)	72 (58.05)	60 (50.77)	52 (46.15)	46 (42.71)	42 (40.39)	59 (50.51)
25	96 (78.65)	92 (73.63)	88 (69.77)	84 (66.44)	78 (62.04)	73 (59.70)	85 (67.23)
30	97 (80.09)	91 (72.55)	87 (68.87)	85 (67.23)	78 (62.04)	72 (58.70)	85 (67.23)
35	96 (78.65)	92 (73.63)	85 (67.23)	83 (65.65)	76 (61.23)	72 (58.70)	84 (66.44)
Mean	81 (67.78)	76 (61.23)	63 (57.59)	66 (54.95)	59 (50.51)	55 (47.59)	
	D		P		D x P		
SEd	0.351		0..385		0.861		
CD (P=0.05)	0.698		0.765		1.710		

(Figures in the parentheses are arcsine values)

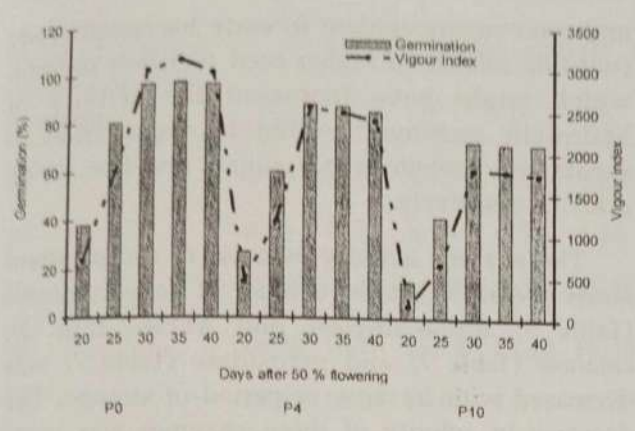

Fig. 1. Effect of stage of harvest on germination and vigour index of rice hybrid CORH-2 during storage

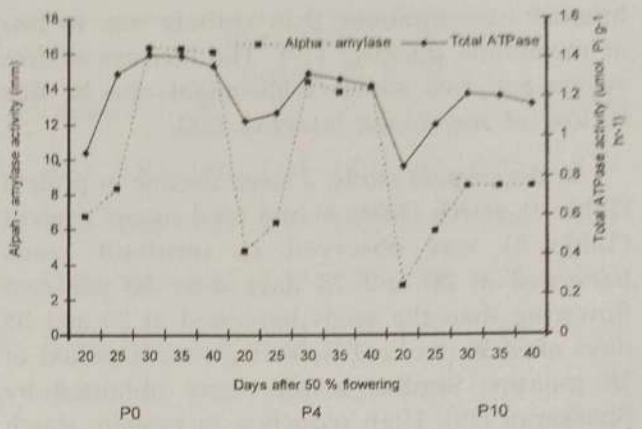

Fig. 2. Effect of stage of harvest on alpha-amylase and total ATPase activity of rice hybrid CORH-2 during storage

Table 2. Influence of stage of harvest on root and shoot length in rice hybrid CORH-2 during storage

Stage of harvest (Days after 50% flowering)	Root length (cm)							Shoot length (cm)						
	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean
20	14.4	13.5	13.0	12.2	10.1	8.5	11.9	3.6	3.5	3.1	2.3	2.6	2.1	2.9
25	16.5	14.8	14.4	13.5	12.5	11.3	13.8	5.3	5.0	4.9	4.7	4.3	4.0	4.7
25	16.7	20.6	19.8	18.9	17.8	16.8	18.4	9.2	9.0	8.9	8.5	8.1	7.6	8.5
30	20.8	20.2	19.4	18.9	17.9	17.0	19.0	10.1	9.6	8.9	8.5	8.1	7.6	8.8
35	20.1	20.3	19.3	18.9	17.8	16.6	18.8	10.5	9.7	8.6	8.3	7.9	7.5	8.8
Mean	17.7	17.9	17.2	16.5	15.2	14.0		7.7	7.4	6.9	6.6	6.2	5.8	
	D		P	DxP				D		P	DxP			
SEd	0.533		0.584	1.305				0.099		0.108	0.242			
CD	1.058		1.159	NS				0.196		0.215	0.481			

Table 3. Influence of stage of harvest on dry matter production and vigour index in rice hybrid CORH-2 during storage

Stage of harvest (Days after 50% flowering)	DMP (mg seedling^{-1})							Vigour index						
	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean
20	6.80	6.28	6.05	5.70	7.20	4.80	6.14	684	578	434	363	228	153	407
25	8.10	7.60	7.20	6.95	6.50	6.08	7.07	1746	1433	1158	939	775	643	1116
25	11.30	11.15	10.08	9.85	9.45	8.98	10.14	2962	2725	2526	2303	1933	1779	2371
30	10.85	10.25	9.90	9.73	9.35	8.80	9.81	3080	2716	2456	2329	2018	1769	2383
35	10.80	10.25	9.90	9.73	9.35	6.63	9.78	2934	2585	2356	2260	1953	1734	2303
Mean	9.57	9.10	8.63	8.39	7.97	7.46		2281	2007	1786	1639	1381	1215	
	D		P	DxP				D		P	DxP			
SEd	0.094		0.103	0.231				30.07		32.94	73.67			
CD (P=0.05)	0.188		0.205	NS				59.75		65.45	146.35			

internal concentrations than entirely due to loss of membrane integrity [17]. The increase of free sugars and free amino acids might also be due to loss of membrane integrity [18].

In the present study, a steep decline in protein (Table 4), starch (Table 8) and total sugars content (Table 5) was observed in resultant seeds harvested at 20 and 25 days after 50 per cent flowering than the seeds harvested at 30 and 35 days after 50 per cent flowering over a period of 10 months. Similar results were obtained by Bhaskaran [19]. High reduction in protein, starch and total sugars content in early harvested seeds could be related to higher seed moisture content, which might have increased the activity of hydrolytic enzymes leading to degradation of sugars and protein to free sugars and free amino acids, respectively.

The enzyme activity assayed in the resultant seeds revealed that the activity of dehydrogenase (Table 5), alpha-amylase and ATPase (Fig. 2), catalase (Table 7) and peroxidase (Table 7) was decreased with increase in period of storage. The decrease in activity of these enzymes was more

Table 4. Influence of stage of harvest on electrical conductivity and protein content in rice hybrid CORH-2 during storage

Stage of harvest (Days after 50% flowering)	Electrical conductivity (dSm^{-1})							Protein content (%)						
	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean
20	0.288	0.299	0.301	0.351	0.381	0.398	0.336	5.08	4.99	4.44	4.15	3.78	3.08	4.25
25	0.271	0.287	0.292	0.233	0.314	0.320	0.286	5.34	5.23	4.85	4.40	4.05	3.93	4.63
25	0.209	0.245	0.273	0.289	0.303	0.314	0.272	8.82	8.58	8.17	8.00	7.85	7.55	8.16
30	0.214	0.250	0.269	0.290	0.303	0.318	0.274	8.60	8.50	8.16	7.93	7.75	7.35	8.05
35	0.238	0.259	0.278	0.297	0.306	0.314	0.282	8.48	8.40	8.08	7.88	7.65	7.48	7.99
Mean	0.244	0.268	0.282	0.292	0.321	0.333		7.26	7.14	6.74	6.47	6.22	5.88	
	D		P		DxP			D		P		DxP		
SEd	0..007		0.008		0.018			0.043		0.047		0.104		
CD(P=0.05)	0..015		0.016		0.036			0.085		0.093		0.207		

Table 5. Influence of stage of harvest on total sugars and dehydrogenase activity in rice hybrid CORH-2 during storage

Stage of harvest (Days after 50% flowering)	Total sugars (mg g^{-1})							Dehydrogenase activity (OD)						
	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean
20	0.369	0.339	0.322	0.308	0.278	0.218	0.306	0.025	0.020	0.019	0.015	0.012	0.011	0.017
25	0.473	0.445	0.432	0.406	0.364	0.309	0.405	0.066	0.059	0.054	0.049	0.040	0.035	0.051
25	0.646	0.620	0.425	0.411	0.403	0.321	0.471	0.153	0.151	0.121	0.110	0.102	0.101	0.123
30	0.654	0.632	0.429	0.411	0.393	0.323	0.474	0.148	0.144	0.126	0.105	0.102	0.100	0.121
35	0.634	0.604	0.428	0.411	0.398	0.327	0.467	0.152	0.146	0.121	0.111	0.102	0.101	0.122
Mean	0.555	0.528	0.407	0.389	0.367	0.300		0.109	0.104	0.008	0.078	0.072	0.069	
	D		P		DxP			D		P		DxP		
SEd	0..005		0.005		0.012			0.024		0..020		0.059		
CD (P=0.05)	0.009		0.011		0.024			0.048		0.032		NS		

Table 6. Influence of stage of harvest on alpha - amylase and total ATPase activity in rice hybrid CORH-2 during storage

Stage of harvest (Days after 50% flowering)	Alpha-amylase activity (mm)							Total ATPase activity (µmole Pi $g^{-1}hr^{-1}$)						
	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean
20	6.75	5.75	4.75	4.00	3.73	2.75	4.62	0.92	1.01	1.08	1.01	0.97	0.85	0.97
25	8.35	7.35	6.35	6.18	5.88	5.85	6.66	1.32	1.31	1.27	1.12	1.10	1.06	1.19
25	16.35	15.35	14.35	13.05	10.25	8.38	12.96	1.42	1.39	1.37	1.32	1.29	1.21	1.33
30	16.28	15.28	13.78	13.15	10.30	8.38	12.86	1.41	1.38	1.38	1.29	1.26	1.20	1.32
35	16.05	15.05	14.05	13.13	10.28	8.40	12.83	1.36	1.36	1.35	1.26	1.23	1.16	1.29
Mean	12.76	11.76	10.66	9.90	8.09	6.75		1.28	1.30	1.29	1.20	1.17	1.09	
	D		P		DxP			D		P		DxP		
SEd	0.123		0.135		0.302			0.0284		0.031		0.070		
CD (P=0.05)	0.245		0.269		0.601			0.0563		0.062		NS		

Table 7. Influence of stage of harvest on catalase and peroxidase activity in rice hybrid CORH-2 during storage

Stage of harvest (Days after 50% flowering)	Alpha-amylase activity (mm)							Total ATPase activity (µmole Pi $g^{-1}hr^{-1}$)						
	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean
20	1.90	1.87	1.85	1.25	1.03	0.98	1.48	0.0548	0.0515	0.0520	0.0472	0.0470	0.0248	0.0462
25	2.58	2.48	2.29	2.21	1.99	1.98	2.26	0.0606	0.0645	0.0558	0.0545	0.0525	0.0364	0.0541
25	3.04	2.67	2.49	2.29	2.07	1.99	2.43	0.0838	0.0808	0.0763	0.0698	0.0648	0.0411	0.0694
30	3.05	2.58	2.38	2.25	2.09	2.16	2.42	0.0853	0.0800	0.0730	0.0695	0.0681	0.0418	0.0696
35	2.98	2.51	2.36	2.23	2.09	1.97	2.36	0.0860	0.0808	0.0733	0.0693	0.0430	0.0400	0.0654
Mean	2.71	2.42	2.27	2.05	1.85	1.82		0.0741	0.0715	0.0661	0.0621	0.0551	0.0368	
	D		P		DxP			D		P		DxP		
SEd	0.038		0.041		0.092			0.001		0..001		0.003		
CD (P=0.05)	0.075		0.082		0.183			0.002		0..003		0.006		

in seeds harvested at 20 and 25 days after 50 per cent flowering than harvested at 30 and 35 days after 50 per cent flowering during storage.

Decline in seed vigour and germination might be ascribed to decrease in activity of these enzymes as they positively correlated with seed vigour and germination. Decreasing activity of alpha-amylase with decline in seed vigour of rice seeds was observed by Ramegowda [18] which is in conformity with the present findings.

The results obtained from the storage study of resultant seeds from different stages of harvest showed that the seed harvested at early stages viz., 20 and 25 days after 50 per cent flowering lost their viability quickly while the seeds harvested at 30 and 35 days after 50 per cent flowering retained their storability over a period of 10 months. These results indicate that the seeds (F_1) of rice hybrid CORH-2 harvested at 30-35 days after 50 per cent flowering could be stored for a period of 10 months.

Table 8. Influence of stage of harvest on starch, free sugars and free amino acids content in rice hybrid CORH-2 during storage

Stage of harvest (Days after 50% flowering)	Starch (%)							Free sugars (µg ml^{-1} of seed leachate)							Free amino acids (µg ml^{-1} of seed leachate)						
	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean	P_0	P_2	P_4	P_6	P_8	P_{10}	D mean
20	62.98	60.98	58.75	57.98	52.30	49.63	**57.10**	7.73	8.92	11.12	12.50	13.21	14.50	**11.33**	6.52	7.03	8.25	9.53	10.53	10.56	8.74
25	65.45	63.65	61.48	60.45	59.20	57.25	**61.24**	10.10	10.60	10.80	11.10	12.10	13.10	11.3	7.43	7.90	8.13	8.43	9.43	10.43	8.62
25	72.65	70.65	68.65	67.65	65.65	63.78	**68.17**	7.05	7.53	7.75	8.05	9.05	10.05	8.25	4.38	4.48	5.08	5.38	8.20	7.35	5.81
30	72.50	70.98	68.73	67.73	66.43	63.30	**68.28**	5.20	5.70	5.30	6.20	7.20	8.20	**6.30**	4.25	4.70	4.90	5.25	4.73	7.25	5.18
35	72.78	70.28	68.78	67.25	65.85	63.75	**68.12**	6.65	7.10	7.30	7.10	8.60	9.60	7.73	4.25	4.75	5.08	5.25	6.25	7.25	5.47
Mean	**69.27**	**64.30**	**65.28**	**64.21**	**61.93**	**59.54**		7.35	7.97	**8.45**	**8.99**	**10.03**	**11.09**		5.37	5.77	**6.29**	6.77	7.83	8.57	
	D	P	DxP	D	P	DxP		D	P	DxP											
SEd	1.699	1.861	4.162	0.128	0.141	0.315		0.266	0.292	0.651											
CD(P=0.05)	3.375	3.698	NS	0.256	0.281	NS		0.528	0.579	NS											

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