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Prediction of storability of organically produced paddy seeds through natural and accelerated ageing techniques

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Abstract: The present study was conducted to know the storage potential of organically produced paddy seeds in the Department of Seed Science and Technology, University of Agricultural Sciences, Raichur. The seed lot were divided into two parts, one part was stored in cloth bag for a period of 12 months under ambient conditions. At the same time another set of seeds were subjected to accelerated ageing at 42 + 1^{0}C temperature and 90 per cent relative humidity (RH) for a period of 0-12 days. Among the ageing methods, artificially aged seeds showed drastic decreases in seed quality as compared to natural ageing. Among the treatments T_9 (37.5 % FYM + 37.5 % vermicompost + 25 % neem cake + foliar spray of panchagavya on 30, 60, 90 and 120 DAT) recorded significantly highest seed quality parameters *viz*., seed germination (97.81 %), seedling length (29.42 cm) and SVI (2878) at initial stage in both the method of aging and at the end of storage period; seed germination (71.23 and 87.33 %), seedling length (19.66 and 27.00 cm) and SVI (1400 and 2358) in accelerated ageing (AA) and natural ageing (NA) respectively,whereas, lowest in control (Inorganic treatment). The seed quality parameters of four days of AA were similar to that of six months of NA. Hence, storability of organically produced paddy seeds were better as compared to inorganic seeds and it can be predicted that four days of AA is equal to six months of NA. The information generated will be useful in retention or disposal of a particular variety or seed lot.

Keywords: Accelerated ageing, Natural ageing, Paddy, Prediction, Storability

INTRODUCTION

Seeds are uniquely equipped to survive as viable regenerative organisms until the time and place are right for the beginning of a new generation. However, like other forms of life, they cannot retain their viability indefinitely and eventually deteriorate and die. High quality seed shows no appreciable drop in germination (Vijayan, 2005). Standard germination test does not predict the extent of deterioration that occur in seeds, which is the sole deficiency of germination test for predicting relative storage potential of seeds (Shantappa Tirakannanavar *et al*., 2006). Many a time most of the seed producers (private or government organizations) will be forced to store a part of the seed produced may be because of excess production or due to less demand of the product. Under these circumstances, they will be put under confusion to take the decision or which seed lot need to be stored and which are need to be disposed off immediately. This emphasizes the need for a suitable technique through which we can assess the relative storability of seeds. Till date there is no widely accepted methods for measuring the relative storage potential of seed lot. However, stress test known as accelerated ageing test has been first developed by (Delouche, 1965) at Mississippi State University. Accelerated Ageing (AA) test show greater potential as a test for predicting the relative storability of different seed lots of crops (Desai, 1976). This test operate on the principle that under high temperature (40-45 ^{0}C) and high relative humidity (90-100 %) conditions for short period, increases the catabolic changes at the cellular levels beyond the threshold of tolerance leading to reduction in seed quality parameters (Vasudevan *et al*., 2012). It is assumed that the process of deterioration under AA condition is same as in natural ageing (Delouche and Baskin, 1973). Hence, it is possible to predict the relative storability of a particular seed lot by exposing to high temperature and relative humidity for different durations and comparing the results with natural ageing. Keeping these in view an experiment was conducted with the objective of determining the storage potential of organically produced paddy seeds through accelerated ageing technique.

MATERIALS AND METHODS

Studies were undertaken at the Department of Seed Science and Technology, University of Agricultural

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Sciences, Raichur to know the storage potential of organically produced paddy seeds during 2013. Freshly harvested organically produced bulk seeds obtained from field experiment conducted by application of different nutrient treatments *viz*., T_1- control (RDF 100: 50: 50 kg NPK kg^{-1} ha), T_2-100 % RDN through FYM , T_3-100 % RDN through vermicompost (VC), T_4-50 % RDN through FYM + 50 % RDN through VC, T_5-37.5 % RDN through FYM + 37.5 % RDN through VC + 25 % RDN through neem cake, T_6-T_2 + panchagavya @ 3 %, T_7-T_3 + panchagavya @ 3 %, T_8-T_4 + panchagavya @ 3 %, T_9-T_5 + panchagavya @ 3 %, T_{10}-Green manuring (Organic farmer practices) and foliar spray of panchagavya at 30, 60, 90 and 120 days after transplanting. The seed lot of each treatment was divided into two parts out of which one part was subjected to accelerated ageing at 40 + 1 ^{0}C temperature and 98 per cent relative humidity (RH) by keeping them in monolayer on a wire mesh for a period of 0-12 days (Delouche and Baskin, 1973). Accelerated aged samples were drawn at an interval of two day and subjected for different test to determine various quality parameters. At the same time sizable quantity of another part seeds were placed in cloth bag and stored for a period of 12 months and the observations on various seed quality parameters were recorded once in two months. The germination test was conducted in top of paper method (Anonymous, 2013). The seedling length of 10 randomly selected normal seedlings from germination test was measured from tip of shoot to root tip and the mean length was calculated and expressed as seedling length in centimeters. The seedling vigour index was determined by multiplying the percentage germination and total seedling length (Abdul-Baki and Anderson, 1973). The experiment was conducted in completely randomized design with four replication. The data obtained was statistically analysed as per (Panse and Sukhatme, 1978).

RESULTS AND DISCUSSION

There exist significant differences in the seed quality parameters (Tables 1-3) due to treatments (application of different sources of nutrients). The seed quality parameters *viz*., mean seed germination (94.48 %), seedling length (27.29 cm) and SVI (2578) were same at initial stage of ageing and decreased with advancement of storage period in both the ageing methods. Whereas, mean seed germination (67.95 and 82.79 %), seedling length (18.38 and 24.17 cm) and SVI (1249 and 2001) were recorded at the end of AA and NA, respectively. Artificially aged seeds showed drastic decreases in seed quality as compared to natural ageing because of adverse effect of higher temperature and relative humidity leads to faster depletion of food reserves (Kovalenko *et al*., 1977); loss of membrane integrity, denaturation of protein and enzyme system and ultra structural changes (Roberts, 1972). Similar results were also observed by (Manimekalai, 2006) in black gram *i.e*. application of organics to seed and seed crop helps to increase seed quality by improving nutrient composition of seed and (Vijayan and Krishnaswamy, 2014) studied the impact of organic techniques of seed crop management on seed quality and reported that seed grown under organic condition recorded better quality as compared to inorganic method in paddy.

Among the treatments T_9 (37.5 % FYM + 37.5 % vermicompost + 25 % neem cake + foliar spray of panchagavya on 30, 60, 90 and 120 DAT) recorded significantly highest seed quality parameters *viz*., seed germination (97.81 %), seedling length (29.42 cm) and SVI (2878) at initial stage in both the method of aging. Whereas at the end of storage period; seed germination (71.23 and 87.33 %), seedling length (19.66 and 27.00 cm) and SVI (1400 and 2358) in AA and NA respectively. The lowest seed germination (61.23 and 77.59 %), seedling length (15.29 and 19.92 cm) and SVI (936 and 1546) in AA and NA respectively were recorded in inorganic treatment (RDF). The retention of higher germination potential may be due to initial vigour potential of resultant seeds (T_9). Better germination of seeds in the treatment (T_9) might be due to combined application of different sources of nutrients which helps to supply of both macro and micro nutrients there by better growth and development of plant. Panchagavya spray might also contribute for proper development of seed and virtue of its effect on enhancing the level of growth promoting substances in the seed brought out additional benefit there by increases in germination and vigour. Similar findings influence of organic manure on the plant growth and seed quality parameters in sesame and seed quality parameters of organic upland rice seed production was reported by (Vijayakumari and Hiranmai, 2012) and (Raumjit Nokkoul, 2014) respectively. The accelerated ageing

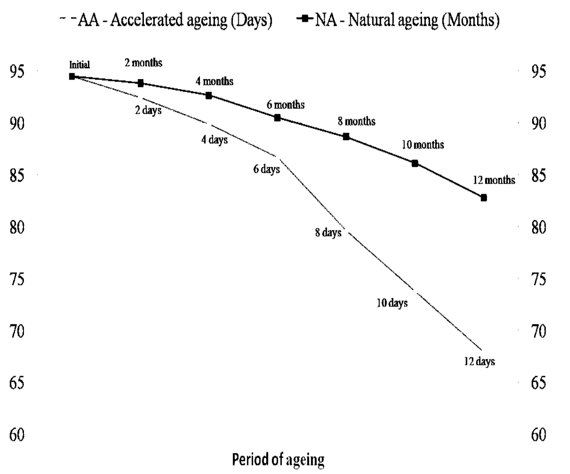

Fig.1. *Prediction of relative storability of seeds though accelerated and natural ageing.*

Table 1. Influence of accelerated ageing (AA) and natural ageing (NA) on germination (%) of organically produced paddy seeds (cv. Sona masoori).

Treatments (T)	Ageing in days (AA)							Treatments (T)	Ageing in months (NA)						
	Initial	2	4	6	8	10	12		Initial	2	4	6	8	10	12
T_1	92.22	90.91	86.57	81.09	75.00	69.30	61.23	T_1	92.22	92.00	90.38	87.04	84.40	80.20	77.59
T_2	93.06	90.73	87.50	85.82	77.63	71.91	69.08	T_2	93.06	92.08	91.46	88.60	86.33	84.60	82.63
T_3	93.16	90.93	88.20	85.75	79.03	73.50	67.61	T_3	93.16	92.37	91.56	88.90	87.08	85.40	81.68
T_4	93.11	90.77	88.09	85.81	78.50	72.22	67.50	T_4	93.11	92.15	91.50	88.64	86.96	85.23	82.00
T_5	94.39	91.20	89.07	86.06	78.81	72.50	67.90	T_5	94.39	93.57	91.74	89.27	87.96	85.73	82.00
T_6	95.41	93.25	91.48	88.10	80.16	74.90	68.21	T_6	95.41	94.08	93.18	91.91	90.30	88.17	83.63
T_7	96.16	94.01	92.70	88.98	82.90	76.38	69.51	T_7	96.16	95.63	93.70	92.91	91.57	88.79	84.78
T_8	96.23	95.61	93.91	89.72	82.02	76.45	70.45	T_8	96.23	96.01	95.63	94.17	92.78	89.27	85.78
T_9	97.81	95.66	93.94	90.97	84.51	78.90	71.23	T_9	97.81	97.36	95.69	94.23	92.80	90.21	87.33
T_{10}	93.21	91.10	87.00	84.15	77.33	71.32	66.80	T_{10}	93.21	92.67	91.70	89.09	86.01	83.41	80.48
Mean	94.48	92.42	89.86	86.64	79.59	73.74	67.95	Mean	94.48	93.79	92.65	90.48	88.62	86.10	82.79
SEm±	0.58	0.33	0.36	0.35	0.34	0.31	0.33	SEm±	0.58	0.57	0.56	0.63	0.57	0.55	0.52
CD @ 1 %	1.74	0.99	1.09	1.08	1.03	0.94	1.00	CD @ 1 %	1.74	1.70	1.68	1.89	1.71	1.65	1.56

Table 2. Influence of accelerated ageing (AA) and natural ageing (NA) on seedling length (cm) of organically produced paddy seeds (cv. Sona masoori).

Treatments (T)	Ageing in days (AA)							Treatments (T)	Ageing in months (NA)						
	Initial	2	4	6	8	10	12		Initial	2	4	6	8	10	12
T_1	24.14	23.96	21.00	19.78	18.02	15.72	15.29	T_1	24.14	23.40	22.71	21.83	21.41	20.78	19.92
T_2	25.43	25.24	23.08	21.94	21.01	19.13	17.67	T_2	25.43	24.57	24.10	23.60	23.02	22.75	22.21
T_3	26.95	26.48	24.47	23.53	21.90	19.83	18.27	T_3	26.95	26.40	25.65	25.11	24.48	23.81	23.49
T_4	25.65	25.24	23.12	22.10	21.09	19.58	18.01	T_4	25.65	25.33	24.91	24.20	23.66	23.30	22.38
T_5	27.51	28.01	26.09	24.36	22.40	20.38	18.81	T_5	27.51	27.00	26.47	26.23	25.71	25.19	24.71
T_6	28.47	28.28	26.89	24.99	23.12	20.98	19.12	T_6	28.47	28.18	27.41	26.92	26.62	26.34	25.40
T_7	28.84	28.41	27.10	25.57	23.78	21.48	19.38	T_7	28.84	28.74	28.28	27.73	27.24	26.69	25.98
T_8	29.17	28.85	27.59	26.50	23.94	21.77	19.57	T_8	29.17	29.05	28.81	28.38	27.94	27.41	26.81
T_9	29.42	29.12	27.84	26.72	24.07	21.90	19.66	T_9	29.42	29.23	28.94	28.52	28.13	27.69	27.00
T_{10}	27.29	27.87	25.82	23.87	21.91	20.00	18.15	T_{10}	27.29	26.58	26.21	25.66	25.10	24.60	23.83
Mean	27.29	27.14	25.38	23.92	22.13	20.08	18.38	Mean	27.29	26.85	26.35	25.82	25.33	24.86	24.17
SEm±	0.20	0.18	0.17	0.19	0.18	0.17	0.18	SEm±	0.20	0.18	0.17	0.16	0.17	0.18	0.18
CD @ 1 %	0.60	0.55	0.50	0.56	0.53	0.52	0.54	CD @ 1 %	0.60	0.58	0.50	0.49	0.52	0.55	0.54

Table 3. Influence of accelerated ageing (AA) and natural ageing (NA) on seedling vigour index of organically produced paddy seeds (cv. Sona masoori).

Treatments	Ageing in days (AA)							Ageing in months (NA)						
(T)	**Initial**	**2**	**4**	**6**	**8**	**10**	**12**	**Initial**	**2**	**4**	**6**	**8**	**10**	**12**
T_1	2226	2178	1818	1604	1352	1089	936	2226	2153	2053	1900	1807	1667	1546
T_2	2367	2290	2020	1883	1631	1376	1221	2367	2262	2204	2091	1987	1925	1835
T_3	2511	2408	2158	2018	1731	1458	1235	2511	2439	2349	2232	2132	2033	1919
T_4	2388	2291	2037	1896	1656	1414	1216	2388	2334	2279	2145	2057	1986	1835
T_5	2597	2555	2324	2096	1765	1478	1277	2597	2526	2428	2342	2261	2160	2026
T_6	2716	2637	2460	2202	1853	1571	1304	2716	2651	2554	2474	2404	2322	2124
T_7	2773	2671	2512	2275	1971	1641	1347	2773	2748	2650	2576	2494	2370	2203
T_8	2807	2758	2591	2378	1964	1664	1379	2807	2789	2755	2673	2592	2447	2300
T_9	2878	2786	2615	2431	2034	1728	1400	2878	2846	2769	2687	2610	2498	2358
T_{10}	2544	2539	2246	2009	1694	1426	1212	2544	2463	2403	2286	2159	2052	1918
Mean	2578	2508	2281	2072	1761	1481	1249	2578	2518	2441	2336	2245	2140	2001
SEm±	64	52	50	47	43	40	38	64	69	77	78	80	77	79
CD @ 1 %	194	155	150	141	130	121	115	194	205	230	232	238	231	233

seems to be promising tool for evaluating the seed vigour and predicting relative storage potentiality. The results of accelerated ageing are almost similar to the results of natural ageing as evident by present study. The mean seed germination of four days of AA (89.86 %) was similar to that of six months of NA (90.48 %) as depicted in (Fig. 1). Similar result that is seed quality as influenced by accelerated and natural ageing in bitter gourd was reported by (Shantappa Tirakannanavar *et al*., 2006) and they predicted that seed quality deterioration in accelerated ageing was similar to that natural ageing except rate of deterioration.

Conclusion

From this study it was concluded that storability of organically produced paddy seeds were better (14 months) as compared to inorganic seeds (10 months) and it can be predicted that four days of accelerated ageing with mean seed germination (89.86) is equal to six months of natural ageing with mean seed germination (90.48).

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