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Effect of Desiccant (Zeolite) beads on Storage Life and Quality of Rice Seed *(Oryza sativa L.)*

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Abstract

The present study was conducted on storage of rice seed using desiccant (Zeolite) beads made of aluminum silicate to study the effect of the beads on seed longevity and quality of rice (BPT-5204) during July, 2013 to November, 2014 at Seed Research and Technology Centre, Rajendranagar. The treatments included storing the seed in air tight container; storing the seed in air tight container with silica gel (1:0.17); storing the seed in air tight container with zeolite beads (1:0.35); seed in cloth bag and seed stored in gunny bag (Control) under ambient storage conditions. The experiment was conducted using completely randomized design with three replications. Data was collected on seed quality parameters in alternate months during the storage period and statistically analyzed. The study revealed that rice seed lots stored in air tight container along with zeolite beads was significantly superior compared to other treatments with respect to germination per cent (80), field emergence (81%), seedling vigour index (8.19) based on seedling dry weight and seedling vigour index (1828) based on seedling length after a period of 16 months storage followed by seed lots stored in airtight containers along with silica gel. However, the seed lots stored in gunny bag was inferior as it recorded a lower germination per cent of 24, field emergence (43%), seedling vigour index (SVI I) based on seedling dry weight (2.65) and seedling vigour index (SVI II) based on seedling length (180) at the end of storage period of 16 months.

Key words: Seed, storage, zeolite, moisture

Introduction

Seeds are hygroscopic in nature and the moisture content of the seed changes in accordance to the relative humidity of the surrounding environment in which they are stored. In tropical climate, high temperature and humidity cause rapid deteoration of seed in open storage resulting in loss of viability, poor stand establishment, lower productivity and disincentive to invest in improved seeds. In general, seed longevity is reduced by approximately half for every one per cent increase in seed moisture content or five degrees increase in temperature and effects are additive (Miller and Lawrence, 1998). Thus, combination of temperature and moisture content results in rapid loss of viability.

Generally, the moisture content of the seeds harvested at physiological maturity is high (15-18%). For safe seed storage the moisture content need to be brought down to 6-13%. However, if seeds are dried to low moisture content, these are much better able to survive in storage even at high temperatures (Sastry *et al.*, 2007). Majority of crop seeds in India are locally produced, stored and utilized. Improved varieties can enhance productivity and quality and expand the market opportunities. Therefore, there is need to develop low cost drying methods as alternative to expensive seed drying equipments in order to lower the moisture content and to maintain safe moisture level for longer storage life. Drying beads are modified ceramic materials (Aluminum silicates or Zeolites) that absorb and hold water molecules very tightly in their microscopic pores. The beads will continue to absorb water until all their pores are filled up to 20 per cent of their initial weight (Nassari *et al*., 2014). Seeds placed in to a container with beads will lose water due to low air humidity and will continue to do so until they come to equilibrium. Thus, it has been proposed that in lieu of humidity controlled and air conditioned storage facilities, which require expensive and reliable energy sources to run and maintain. Seeds

can be dried to low moisture levels and sealed in hermetic containers without temperature control. Zeolite beads are used in the present study due to their micro pores and strong affinity to absorb and hold water very tightly. Thus, seeds can be used for longer period without losing viability and vigour. The current investigation was carried out to study the effect of zeolite beads on storability and seed viability.

Materials and Methods

Freshly harvested seed material of rice variety (BPT-5204) was obtained from Seed Research and Technology Centre, Rajendranagar. The seed material was measured for moisture content and reduced to ten per cent by spreading in a thin layer on ground at a temperature ranging from 29^{0}C to 34 ^{0}C for 30 hours with duration of five hours a day. Then the treatments were imposed *viz*., seed stored in air tight container; seed stored in air tight container with silica gel (1:0.17); seed stored in air tight container with zeolite beads (1:0.35); seed stored in cloth bag and seed stored in gunny bag under ambient conditions. Seeds with 10 per cent moisture content were utilized for testing the longevity during storage. The experiment was laid out in CRD replicated thrice. The containers were kept under ambient storage conditions. Bimonthly observations on germination per cent (ISTA, 2004), moisture percent (ISTA 2004), field emergence and seedling vigour index (SVI) (Abdul-Baki and Anderson, 1973) were recorded. The data were statistically analyzed using Anova technique (Panse and Sukhatme. 1985). Standard error of difference was calculated at 5 per cent probability level to compare the mean difference among the treatments.

Results and Discussion

Mean initial germination per cent of seed lots stored in different containers was 95.3 and there was no significant difference among the treatments. After a storage period of 16 months, the germination per cent was reduced drastically in all the treatments. However, germination per cent in the seed lot stored in air tight container along with drying beads (80 %) was significantly superior followed by seed lot stored in air tight container along with silica gel (53%) (Tables 1 and 2). The seed lots stored in gunny bag recorded the lowest germination per cent of 24% at the end of storage period. Similar findings were reported by Kong and Zhang (1998) by storing the asparagus beans along with silica gel with a ratio of 4:1. Further, Eklou *et al.,* (2006) also found that rice seed stored with silica gel at the ratio of 1:1 could reduce the moisture content to five per cent and improved the seed longevity.

The fluctuations in moisture content were more in seed stored in cloth bag and the moisture content was higher at the end of storage period (14%). The seed lot stored in air tight container along with drying beads recorded significantly lower moisture content (5.6 %) followed by seed lot stored in air tight container along with silica gel (7.2%). The moisture trend showed that rice seed (1kg) stored with 350 g of zeolite beads had reduced the moisture to 6.8 per cent at the end of few hours of mixing with beads and this was maintained during the entire storage period (Table 1 and 2). The current findings are in accordance with the work of Ejeromedoghene (2010) who reported that seeds stored with desiccant beads had significantly reduced the moisture content throughout the storage period and also had their viability and vigour better maintained than those stored with other means like silica gel. Therefore, the storage life of the seeds stored under moisture controlled environment usually longer than seeds stored under ambient storage conditions and seed deteoration is faster than the later (Oyekale, 2010). Sastry *et al*. (2007) stated that groundnut seed survived for 20 weeks when seed moisture content decreased from 10.1% to 3.4 %. Seed stored at moisture content of 10.1% deteorated faster and lost viability within a short period. Significant and lower qualitative seed quality parameters were observed in gunny bag during entire storing period may be due to its permeable nature which might have favored the longer fluctuations in moisture content leading to metabolic and respiratory activity of the seeds compared to airtight containers, where in seed quality parameters were comparatively superior with slow rate of seed deteoration. Similar beneficial effects were documented by Venkatasalam (2001) in Tomato and Veena (2007) in Onion.

The superiority of seed lot stored in air tight container along with drying beads also continued for seedling vigour index (Based on seedling length) at the end of the storage period (1828) followed by seed lot stored in air tight container along with silica gel (1808) (Table 1 and 2). Similarly, seedling vigour index based on seedling dry weight recorded highest (11.19%) in the seed lots stored with silica gel. However, the seedling vigour index and field emergence were also higher for seed lot stored with zeolite beads (8.19% and 81.0%) while the seed lot stored in gunny bag recorded the lowest (180) seedling vigour index based on seedling length and 2.65 based on dry

weight. However, field emergence recorded by the seed lot stored in gunny bag was 43 per cent after 16 months of storage. The results are in line with the reports of (Gupta *et al.,* 1989). The seed lot stored in air tight container along with drying beads was found to be superior during storage with respect to all seed quality parameters. Singh and Dadlani (2003) and Usha *et al.,* (1990) also reported significantly superior performance for seed quality parameters for Sesame and Soybean seeds stored along with charcoal.

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Table 1. Effect of drying beads in air tight containers on seed quality parameters of Rice after 2 months of storage

Treatment	Germination (%)	Moisture (%)	Seedling length (cm)	Seedling dry weight (mg)	VI-I	VI-II	FE (%)
T_1- Seed stored in polythene 700 guage ba)	94.3	10.67	32.6	1.53	3074	144.3	83.0
T_2- Seed stored in air tight container	97.0	11.30	32.1	1.52	3113	147.4	89.6
T_3- Seed stored in polythene bag + silica gel	96.0	5.07	31.8	1.6	3052	153.6	91.3
T_4- Seed stored in air tight container + drying beads	94.3	7.00	32.5	1.51	3064	142.4	88.3
T_5- Seed stored in gunny bag	94.7	11.17	30.2	1.54	2859	145.9	86.6
T_6- Seed stored in cloth bag	95.3	15.07	53.0	2.312	3076	146.7	79.0
Mean	0.76	0.183	0.742	0.023	3074	144.3	86.3
S.Em±	2.478	0.596	2.422	0.077	1.35	1.01	3.11
CD at 5%	94.3	10.67	32.6	1.53	427.5	3.19	9.81

Table 2. Effect of drying beads in air tight containers on seed quality parameters of rice after 16 months of storage

Treatment	Germination (%)	Moisture (%)	Seedling length (cm)	Seedling dry weight (mg)	VI-I	VI-II	FE (%)
T2 (Seed stored in air tight container)	51	13.1	15.9	0.112	824	5.83	51.0
T3 (Seed stored in polythene bag + silica gel)	56	12.8	19.5	0.129	1094	7.31	67.0
T4 (Seed stored in air tight container + drying beads)	53	7.2	22.8	0.139	1808	11.2	75.0
T5(Seed stored in gunny bag)	80	5.6	34.5	0.154	1828	8.19	81.0
T6 (Seed stored in cloth bag)	24	13.8	7.5	0.111	180	2.65	43.0
Mean	37	14	9.9	0.12	376	4.48	48.0
S.Em±	50.2	11.1	18.4	0.1	1018	6.62	60.8
CD at 5%	11.5	0.67	5.46	0.015	241.5	2.20	10.2

VI-I: Seedling vigour index based on dry weight;

VI-II: Seedling vigour index based on seedling length

F.E: Field emergence