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Effect of desiccants on seed quality of Brinjal during ultra-dry storage

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Abstract
An experiment was conducted at Seed Quality Research Laboratory of National Seed Project, University of Agricultural Sciences, Dharwad during 2017-2018 to evaluate the effect of desiccants on seed quality of brinjal seeds during storage which constituted three desiccants viz., zeolite beads, bentonite granules and charcoal granules and was laid out in completely randomized design with four treatments and five replications. The seed moisture content was reduced to desired level by adding desiccants.
Among the four different treatments, zeolite beads recorded the highest germination (84.6%), seedling vigour index (927) and maintained the lowest moisture content (3.80%), Whereas, the seeds stored in without desiccant deteriorated rapidly in all the seed quality parameters and recorded the lowest germination (72%), seedling vigour index (675), and higher moisture content (9.45%) at the end of nine month of storage period. Therefore, it can be concluded that the zeolite beads and other desiccants can be safely used for seed drying without impairment in seed quality of brinjal.

Keywords: Brinjal seeds, desiccants, drying, moisture, hermetic container

Introduction
Brinjal is also called as eggplant, a popular solanaceous vegetable fruit crop and is native to India. It is a versatile crop adapted to different agro-climatic regions and can be grown throughout the year. The world acreage under brinjal vegetable crop is 1.87 million hectare with a production of 49.42 million tonnes and with an average productivity of 26.43 tonnes per hectare. In India it is grown on an area of 669 thousand ha with a production of 12400 thousand tonnes (Anon, 2017) [4].

Seed is the critical input of agricultural/horticulture/vegetable production on which depends on the performance and efficacy of other inputs. Quality seeds appropriate to different agro-climatic conditions and sufficient quantity at affordable prices are required to raise the productivity of crop. Seed quality depends on factors like seed source, time of harvest, techniques of harvesting and processing including seed drying and storage practices. Special techniques are required for seed collection, handling, processing and storage of the seeds. Generally seeds are dried under the sun, if the crop is harvested during rainy season or under cloudy weather it is very difficult to dry the seed. In such condition, high temperature and humidity combine to cause rapid deterioration of seeds under ambient conditions of storage resulting in low seed quality, poor stand establishment, lower productivity and disincentive to invest on improved seeds.

Delay in drying or slow drying together with high temperature (above 25 °C) will tend to reduce viability considerably in orthodox seeds. The recommended methods for safe seed drying to a very low moisture content using seed drying chambers or seed dryers, where the relative humidity of the drying environment is controlled (Ellis *et al.,* 1995) [6]. It may not be easily implemented in the seed industry due to the high cost of establishing, running and maintaining. Therefore, there is a need for low cost drying methods to be used as an alternative to such expensive seed drying equipment's in order to lower the moisture content and to maintain safe moisture level suitable for seed storage to suit all the situations i.e. from individual small farmers to big seed growers. As an alternative desiccant drying technology or seed drying using desiccant is feasible and economically viable proposition. Keeping all above factors in consideration the present investigation was planned to know the effect of desiccants on seed quality of brinjal during storage with an objective to study the seed quality parameters of vegetables under dry storage condition.

Materials and Methods

The storage experiment was conducted in the Seed Quality Research Laboratory of National Seed Project, Seed unit, College of Agriculture, Dharwad, on effect of desiccants on quality of brinjal seeds during ultra dry storage. The required quantity of desiccants was calculated based on their adsorption capacity to reduce to safe level seed moisture content. Initial moisture content of seeds were 8.0%. Quantity of desiccants stored in brinjal was 0.21 kg for zeolite beads (as per Rhino Research table) and one kilogram bentonite and five kilograms activated charcoal per kilogram of brinjal seeds, respectively. Brinjal seeds were then mixed with the desiccants and kept in hermetic container and stored for nine months under control condition from July, 2017 to March, 2018. The experiment consisted of four treatments. viz., T_1: Brinjal seeds stored with Zeolite beads, T_2: Brinjal seeds stored with Bentonite granules, T_3: Brinjal seeds stored with Charcoal granules and T_4: Brinjal seeds stored without desiccant under controlled condition as control. Relative humidity and temperature present in the hermetic container was noted by using EXTECH Hygro-thermometer with direct readings. These hygro-thermometers placed in each hermetic container and readings were noted 24 h. interval throughout the storage period.

The Seed germination percentage was worked out as per the procedure given by ISTA (Anon., 2014), seedling vigour index was worked out as per the formula given by Abdul-Baki and Anderson (1973) [1] and Moisture content (Anon., 2014). The data of the laboratory experiment were analyzed statistically by the procedure prescribed by Gomez and Gomez (2010) [8].

Results and discussion

Seed Germination: The loss in germinability and vigour of seed during storage is an inevitable. These losses occur in storage due to many factors such as moisture content, temperature, relative humidity, length of storage period and storage containers. The initial germination percent was (92.0%) observed in case of brinjal seeds (Manzarigotta). The seed germination percentage was above seed certification standards (70%) in all treatments at 9 months of storage with zeolite beads (T_1) (84.6%), bentonite granules (T_2) (80.0%) and activated charcoal granules (T_3) (78%) (Table1). The germination percent of brinjal seeds has shown significant effect with desiccants after 8 months of storage. The retention of high seed viability with desiccant might be due to slow decreasing of seed moisture at ultra dry conditions i.e., by zeolite beads and bentonite granules during storage which resulted on low seed respiration and maintenance of cell membrane integrity. The faster drying is not always good in retention of seed quality. Similar results were reported by Ellis *et al*. (1991) [7] in onion seeds were high germination up to three years observed when moisture content was maintained from 6.0 to 6.8 percent (dry treatment) or 3.6 to 3.7 percent (ultra dry treatment) and stored under a temperature of 2^0 to 20 ^{0}C. The onion seeds stored in glass container and aluminium foil with silica gel at 5 ^{0}C and -20 ^{0}C retained germination of 90% and 76%, respectively after seven years of seed storage (Doijode, 1995) [5].

Seedling vigour index: The vigour index in brinjal seeds among the different desiccants varied significantly. Seed stored with desiccant zeolite (T_1) (927), bentonite granules (T_2) (842) and charcoal granules (T_3) (783). Seeds stored under control without desiccant has showed significantly lowest seedling vigour index (675) after 9 months of storage period (Table 2). The seeds stored with zeolite beads and bentonite granules maintained low moisture which might have resulted in lower respiration rate, lower metabolic activity and maintenance of higher seed vigour during storage. This lower moisture maintained in airtight container might be responsible for higher germination, seedling length, seedling dry weight and seedling vigour indices as a result of greatly extending storage life as reported by (Hong *et al*., 2005) [9]. Doijode (1995) [5] observed high vigour index I and II of 591 and 162, respectively for the onion seeds stored in glass container with silica gel compared to 415 vigour index I and 113 vigour index II without silica gel.

Moisture content: The seed stored in airtight container with zeolite beads (T_1) showed lowest seed moisture content reduced from 8.00 to 3.80 percent, at the end of nine months storage period followed by bentonite granules (T_2) (5.00%), charcoal granules (T_3) (6.10%) and control (T_4) (9.45%). Moisture content is the key factor for successful seed storage. In the current study, moisture content lowered with zeolite beads at ultra drying level *i.e.,* below 3.6 percent for 8 months and maintained the germination above seed certification standards. Storage of seeds of different species under slowly reduced moisture has been found to maintain viability for a longer period (Agrawal, 1982) [2]. Similarly, in *Ammopiptanthus mongolica* seed could be stored at ambient temperature (25 ^{0}C) with relatively low moisture content and their longevity decreased as seed moisture content increased (Yi *et al*., 2010) [10].

Table 1: Effect of desiccants on germination in brinjal seeds

Treatment	Initial	1 month	2 month	3 month	4 month	5 month	6 month	7 month	8 month	9 month
T_1	92.0 (73.54)	91.0 (72.51)	90.2 (71.73)	90.0 (71.54)	89.2 (70.79)	88.2 (69.88)	87.6 (69.35)	86.2 (68.17)	85.4 (67.51)	84.6 (66.87)
T_2	92.0 (73.54)	91.0 (72.51)	90.0 (71.54)	89.60 (71.16)	88.0 (69.70)	87.4 (69.18)	86.6 (68.50)	85.0 (67.19)	82.6 (65.32)	80.0 (63.41)
T_3	92.0 (73.54)	91.0 (72.51)	90.40 (71.92)	89.0 (70.60)	87.4 (69.18)	86.6 (68.50)	84.8 (67.03)	81.8 (64.72)	79.4 (62.98)	78.0 (62.00)
T_4	92.0 (73.54)	91.4 (72.92)	89.8 (71.35)	87.8 (69.53)	84.0 (66.40)	82.0 (64.87)	79.2 (62.84)	77.0 (61.32)	75.0 (59.98)	72.0 (58.03)
Mean	92.0	91.1	90.1	89.1	87.2	86.1	84.6	82.5	80.6	78.7
S. Em. ±	-	0.77	0.68	0.87	0.74	0.77	0.79	0.75	0.69	0.77
C. D. (P=0.01)	-	NS	NS	NS	3.06	3.17	3.27	3.12	2.83	3.17

Values in parentheses are arcsine root transformed values, without arcsine indicate original values

Table 2: Effect of desiccants on seedling vigour index of brinjal seeds

Treatment	Initial	1 month	2 month	3 month	4 month	5 month	6 month	7 month	8 month	9 month
T_1	1229	1204	1179	1165	1134	1095	1061	1028	962	927
T_2	1229	1198	1159	1145	1096	1059	1029	978	898	842
T_3	1229	1192	1154	1122	1073	1033	979	905	824	783
T_4	1229	1192	1137	1089	1015	959	890	835	757	675
Mean	1229	1197	1157	1130	1079	1036	990	936	860	807
S. Em. ±	-	17.95	25.12	23.70	17.83	19.31	18.24	16.20	10.95	12.92
C. D. (P=0.01)	-	NS	NS	NS	73.64	79.77	75.32	66.90	45.21	53.35

Table 3: Effect of desiccants on moisture content of brinjal seeds

Treatment	Initial	1 month	2 month	3 month	4 month	5 month	6 month	7 month	8 month	9 month
T_1	8.00	5.00	4.40	4.20	4.10	4.00	3.90	3.80	3.80	3.80
T_2	8.00	6.50	5.80	5.50	5.20	5.00	4.80	4.90	4.90	5.00
T_3	8.00	7.00	6.30	6.10	5.90	5.80	5.80	5.90	6.00	6.10
T_4	8.00	8.09	8.18	8.27	8.39	8.50	8.65	8.92	9.20	9.45
Mean	8.00	6.65	6.17	6.02	5.90	5.83	5.79	5.88	6.00	6.11
S. Em. ±	-	0.10	0.09	0.08	0.07	0.07	0.06	0.05	0.04	0.04
C. D. (P=0.01)	-	0.42	0.39	0.33	0.30	0.29	0.26	0.22	0.17	0.16

T_1- Seed stored with zeolite beads T_2-seed stored with bentonite granules
T_3- Seed stored with charcoal granules T_4- Seed stored in hermetic container without desiccant (control).

Conclusion: Based on the above results obtained, it can be concluded that irrespective of desiccants all the seed quality parameters decreased with the advancement of storage period. In general seed storage with desiccant showed better seed quality attributes by reducing its moisture content to a desired level also maintained better in seed quality parameters throughout the storage period. Zeolite bead has professed advantages over other desiccants used in the present study, which include that they have higher regeneration capacity, greater affinity for water, particularly at low humidity.

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