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Original Research Article

Effect of Drying the Seeds to Ultra Low Moisture Content (Ultra-desiccation) on Viability of Sorghum Seeds (Sudexchari-1)

Sonia Saraswat* and Kalyani Srinivasan

National Bureau of Plant Genetic Resources, New Delhi, India

**Corresponding author.*

Abstract

Ultra-desiccation is a cost effective storage technique. In the present study Sorghum seeds with original moisture content of 7% were ultra- desiccated to 3, 4 and 5% to determine physical parameters. The seeds with original moisture content incubated at 60±2ºC for a period of 30 days. On each alternate day viability and seedling vigour was determined. The results indicated that up to 30th day reasonable good viability can be maintained at 3% moisture followed by 4% and 5%. Moreover, root, shoot and coleoptile vigour were also better for seeds conditioned to 3% moisture content. So, it is concluded that by bringing the moisture content down to ultra low levels and incubating at 60ºC for several days, the storage capacity of seed lots can be more assessed.

Keywords

Seed moisture

Sorghum

Ultradesiccation

Introduction

Millets include several genera of which the most important is Sorghum. It can thrive under a wide range of environmental conditions and can stand moisture stress much better than other cereals. It forms staple food in several Asian and African countries. It is used as feed for animals and is a raw material for industrial uses. It is an important food and fodder crop of dry land areas, is mainly concentrated for grain and for fodder production. It occupies an annual area of sixteen million hectares, which is more or less constant since last fifteen years. It is grown for fodder production during summer and kharif (rainy) seasons to meet the requirements of fodder for the livestock. The international board for plant Genetic resources recommends hermetic storage at temperatures of -18ºC or less with 5±1% seed moisture content for the long-term storage of orthodox seeds (Roberts, 1973) for genetic resources conservation. Refrigerated stores are not always available. However the variation in water status among seeds of contrasting species at the same moisture content has effect on longevity.

Food and Agricultural organization of the United Nations (FAO) and the International plant genetic resources institute have recently widened the range of moisture content recommended for long term storage to 3-7% depending upon species. Thus the concept of ultra-dry technology was introduced as a means to reduce or avoid requirement for refrigeration in germplasm facilitated with economic constraints or to reduce low input alternatives for medium to long term cold storage of seed germplasm through its storage at room

temperature (Saraswat, 2006). The technique of ultra-desiccation showed considerable benefit to seed longevity at 50ºC and by reducing seed moisture content in hermetic storage to very low values in the oilseed sesame (*Sesamum indicum*) (Ellis et al., 1985). There is scanty or no information available on the viability maintenance of Sorghum seeds (Sudexchari-1) by Ultra-desiccation technique. Hence the present study aimed to explore the aforesaid.

Materials and methods

Material

The seed material used in the present study includes one species of sorghum species namely, *Sorghum bicolor* cv. Sudexchari-1.

Methodologies (physical parameters)

Germination rate

Germination tests were conducted using 25 seeds in three replications. Seeds were plated in Petri plates with wet filter paper and kept in germinator, maintaining humidity and temperature at 25±2ºC. Germination count was taken every day up to seventh day. Seeds were considered to be germinated of 1mm radicle has emerged. Germinated seeds were removed every day. Germination percentage was recorded on the basis of normal seedlings.

Germination percentage

Germination % tests were conducted using 25 seeds in three replicates. Seeds were plated on germination paper over butter paper and kept in germinator maintaining humidity and temperature of 25±2ºC. Germination percentage count was taken on seventh day.

Speed of germination/mean germination time

Speed of germination same as that of normal test the formula used to calculate speed of germination was.

$$MGT = \frac{\sum nd}{\sum n}$$

n= no. of seeds which germinate on day –d.
d= no. of days counted from the beginning of germination test.

Seedling vigour

Seeds were plated on germination paper. The seeds were arranged on the paper vertically and kept vertically in Germinator. Observations were taken on the seventh day of sowing. Three replications of 10 seeds were sown. The length of roots, shoots and coleoptile was measured on the basis of total no of seeds plated.

Vigour index

Vigour index was calculated by using method of Abdue-Baki and Anderson (1973) using the formula:

Vigour index = root length + shoot length *G%

Results and discussion

An experiment was conducted to investigate the effect of drying the seeds to ultra low moisture content (Ultra-desiccation) on the viability maintenance when aged at 60±2ºC. Ultra-desiccation is a cost effective storage technique. In which the cost of storage can be considerably reduced by enabling the storage of seeds at room temperature for long periods. Sorghum seeds with original moisture content of 7% were ultra- desiccated to 3, 4 and 5%, incubated at 60±2ºC for a period of 30 days. Each packet was removed on alternate day to determine viability and seedling vigour. The results indicated that up to 30th day reasonable good viability was maintained for seeds at 3% moisture followed by 4 and 5% (Table 1, 2 and 3). Corresponding root, shoot and coleoptile vigour were also better for seeds conditioned to 3% moisture.

The International Board for Plant Genetic Resources (IBPGR) recommended hermetic storage at temperatures of -18ºC or less with 5±1% seed moisture content (fresh weight basis) for long term storage of orthodox seeds for genetic resources conservation. Refrigerated stores are not always available. More over the variation in water status among seeds of contrasting species at the same moisture content has considerable effect on longevity. This helps to explain why the Food and Agricultural Organization of the United Nations (FAO) and the International Plant Genetic Resources Institute (IPGRI) have recently widened the range of moisture contents, recommended for long term storage to 3-7% depending upon species. It has been suggested that in order to maximize the longevity of orthodox seeds in gene banks where refrigeration to -18ºC cannot be provided, seeds should first be dried at 20ºC to moisture content in

equilibrium with about 11% relative humidity and then be stored hermetically at ambient or cooler temperatures. Reduction in seed storage moisture content below critical moisture content had no effect on the longevity in some species example mung bean (Ellis et al., 1989). Research on ultra-dry seeds is generally carried out at high temperatures because the longevity of very dry orthodox seeds is considerable at lower temperatures.

Table 1. Mean germination percentage *Sorghum bicolor* cv. Sudexchari-1.

Moisture content%		3.14	4.7	5.4
Control (0 d)		96	98	96
Days	2	96	94.5	90
	4	95	94	90
	6	92	92	84
	8	90	90	82
	10	82	84	76
	12	80	82	74
	14	78	72	72
	16	76	70	50
	18	76	66	42
	20	70	64	40
	22	64	44	30
	24	56	42	22
	26	54	36	10
	28	48	14	8
	30	24	5.6	0
Mean ± SE		69.42 ± 17.36	61.93 ± 15.5	51.26 ± 12.81

Table 2. The root length (cm), shoot length and coleoptile length of *Sorghum bicolor* cv. Sudexchari-1.

Moisture content %	Root			Shoot			Coleoptile		
	3.14	5.4	4.7	3.14	5.4	4.7	3.14	5.4	4.7
Control (0 d)	9.5	9.39	8.14	20.42	19.49	18.8	1.6	1.4	1.25
Days 2	8.74	8.71	7.3	18.2	17.7	18.6	1.08	1.25	0.90
4	8.5	8.58	7.0	17.6	16.76	18.4	1.0	1.06	0.86
6	7.58	8.4	6.33	15.8	14.66	16.7	0.82	0.96	0.77
8	7.0	8.06	6.24	13.07	14.43	13.35	0.78	0.72	0.70
10	6.98	5.8	6.2	12.18	9.4	12.17	0.74	0.58	0.65
12	6.3	5.44	6.15	11.81	8.77	10.7	0.68	0.53	0.57
14	5.24	5.41	5.7	9.9	6.4	8.5	0.66	0.40	0.55
16	5.20	4.7	4.7	9.4	5.9	8.43	0.59	0.38	0.50
18	4.53	1.9	3.2	9.06	2.19	5.8	0.567	0.17	0.46
20	4.4	1.0	3.1	9.02	2.0	5.0	0.562	0.16	0.40
22	4.2	0.63	3.0	9.0	0.77	4.76	0.560	0.13	0.362
24	4.0	0.13	2.0	8.39	0.11	4.2	0.39	0.07	0.360
26	3.5	0	1.26	5.24	0.11	0.39	0.39	0	0.30
28	3.1	0	1.0	4.25	0.1	0.34	0.34	0	0.15
30	2.5	0	0.23	4.1	0	0.33	0.33	0	0.03
Mean ± SE	5.70 ± 1.4	4.33 ± 1.082	4.49 ± 1.12	11.09 ± 2.77	7.30 ± 1.83	8.89 ± 2.22	0.69 ± 0.17	0.77 ± 0.19	0.79 ± 0.20

In the present study sorghum seeds were conditioned to moisture contents of 3, 4 and 5% and sub-lots of each moisture content were stored at 60ºC for 30 days and assessed for their viability and vigour alternate days. Results revealed that seeds desiccated to lowest moisture content of 3% had better vigour and viability at any given day. Seeds at 5% moisture content deteriorated faster than those at 4% moisture content indicating that desiccating Sorghum seeds to ultra-low level of 3% is beneficial and can serve as a cost effective technology. Such seeds can remain viable for several years when stored at ambient room temperature or slightly cooler temperatures. A number of studies have indicated the cost effectiveness of this

technique for several crop seeds**.** Researchers (Nakamura, 1975) showed considerable improvement to lettuce and onion seed survival at moisture content in equilibrium with 10% compare to 30% relative humidity during 15-20 years of storage at room temperature. Ellis et al. (1992) have reported successful survival of very dry seeds stored at warmer temperature through their short term storage studies. In the present study also, the results of short-term storage experiment at 60ºC for sorghum seeds have indicated beyond doubt that this technique will be highly beneficial to these seeds.

Table 3. Vigour index of *Sorghum bicolor* cv. Sudexchari-1.

Moisture content %	3.14	4.7	5.4
Control (0 d)	3025.9	2762.62	2906.88
Days 2	2661.9	2532.6	2489.4
4	2574.5	2468.4	2376.0
6	2231.92	2189.6	2012.64
8	1876.5	1827.0	1936.84
10	1631.8	1597.6	1199.28
12	1503.2	1425.16	1090.76
14	1232.4	1062.0	879.12
16	1154.44	954.1	549.0
18	1075.93	624.36	178.92
20	978.74	544.0	126.4
22	880.64	357.36	45.9
24	715.68	275.52	6.82
26	493.02	70.2	0
28	364.32	20.86	0
30	168.72	3.3	0
Mean ± SE	1410.60 ± 352.65	1169.67 ± 292.42	987.37 ± 246.84

Conclusion

Ultra-desiccation is a cost effective storage technology. The present study in Sorghum showed, that there is marked decreased in germination %, shoot vigour, root vigour, coleoptile vigour and vigour index, in seeds desiccated to moistures greater than 3% as is evident from the result. Hence by bringing the moisture content down to ultra low levels and incubating at 60ºC for several days, the storage capacity of seed lots can be more or less accurately assessed.

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