



Effect of Storage Condition on Seed Quality of Some *Dhaincha* (*Sesbania* spp.) Accessions

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Abstract

An experiment was conducted at the Seed Pathology Laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, to understand the effect of storage conditions on seed quality of different accessions of *dhaincha* (*Sesbania* spp.). Seeds of twenty accessions were collected and stored in a refrigerator (4°C) and laboratory at normal room temperature (25-30°C). Sprouting (%), germination (%), vigour index and the incidence of seed-borne pathogens were recorded following ISTA procedures. Germination and emergence were higher when seeds were stored in the refrigerator than those in room temperature. The vigour index was also high when the seeds were stored in a refrigerator. Fungi belonging to genera *Aspergillus*, *Fusarium*, *Rhizopus*, and *Penicillium* were associated with seeds of the different accessions of *dhaincha*. Seed borne infection of *Fusarium* sp. was highest (14%) in G-13 when seeds were stored at room temperature. It was evident from the results that the quality of the seeds of *dhaincha* accessions was retained for a long time when they were stored at low (around 4°C) temperature.

Keywords: *Dhaincha*, storage condition, seed quality, seed health

1. Introduction

Dhaincha (*Sesbania* spp.), a member of the family Fabaceae, is an ideal green manure crop in Bangladesh (Sarwar *et al.*, 2015). The genus *Sesbania*, consists 60 species encompassing annuals, perennials, herbs, shrubs and trees, is distributed in the tropical and subtropical climates (Veasey *et al.*, 1999). The perennial species of *Sesbania* establish easily and can grow under stress conditions with minimum care. They have many attributes that make them attractive as multipurpose plants and potentially useful species in agricultural production systems (Sarwar *et al.*, 2015). Three species, *viz.* *Sesbania sesban* (L.) Merr., *S. bispinosa* (Jacq.)

Wight and *S. cannabina* (Retz.) Poir are commonly known as “Dhaincha” in Bangladesh (Ahmed *et al.*, 2009).

Seed deterioration is inexorable and non-uniform (McDonald, 2004). Many factors contribute to seed deterioration including genetic composition, seed moisture content, mechanical and insect damage, pathogen attack, seed maturity, and relative humidity and temperature of the storage environment. However, relative humidity and temperature are considered as the most important factors that regulate the seed quality (McDonald, 2004; Basavegowda *et al.*, 2013). Relative humidity directly influences seed moisture. At low temperature (5-7°C), pests incidence are

low, as a result, seed viability and quality remain satisfactory during storage time (Croft *et al.*, 2012). The storage container also affects the quality of seeds at storage (Monira *et al.*, 2012). Similar observations on the superiority of impervious container (polythene lined gunny bag) for maintenance of soybean seeds quality was observed by Sharma *et al.* (1998). Alam *et al.* (2010) had similar findings in case of bean seeds. Dwivedi and Shukla (1990) also narrated similar observations in chickpea. Croft *et al.* (2012) noted seed germination as a function of the duration of storage, air temperature and seed moisture content at storage. Therefore, the study was conducted to determine the effect of storage condition on the health, germination, and emergence of seeds of different *dhaincha* accessions.

2. Materials and Methods

Seeds of twenty *dhaincha* accessions were collected from different parts of Bangladesh in November 2014 (collection information would be available upon request to corresponding author). Seed samples were sun dried, cleaned and divided into two halves. One-half of the seed samples of each accession were stored at room temperature and the other half was stored in a refrigerator at the Plant Systematics Laboratory, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh. In both cases, seeds were in air tight plastic bottles. The temperature inside the refrigerator was 4°C and that in the room temperature was 25-30°C. The seeds were stored for 6 months. At the end of the storage period, samples were collected and the seeds were subjected to germination and health test at the Seed Pathology Laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh.

2.1. Germination test

Germination test was done in the sterile sand medium in plastic containers. Four hundred seeds of each accession were tested. One hundred seeds were placed in a container and considered as one replication. Thus, there were

four replications. The number of normal and abnormal seedlings, dead and non-germinated seeds were counted after 10 days of seed sowing. Percentage of germination was calculated. Root and shoot length (cm) of 20 seedlings were measured. Seedling vigour was determined following Baki and Anderson (1972):

Vigour Index = (Root length + Shoot length) × Germination (%)

2.2. Seed health test

Seed health tests were done by Dry Inspection and Blotter Incubation method following ISTA (2001) procedure. In the dry inspection, the seeds of each accession were categorized into healthy, small and shriveled seeds on the basis of visual diagnosis with the aid of hand lens. Blotter incubation test was done on Whatman No. 1 blotter paper contained in plastic petridishes. Three layer of water soaked blotter papers were placed on each petridishes and 25 seeds/dish were placed. The seeds were incubated in the incubation chamber. After five days, number of seeds with mycelia colonies was counted. The genera of fungi were identified under the compound microscope at 40x, with the help of manuals of seed borne fungi.

2.3. Data Analysis

Data were analyzed statistically following the analysis of variance (ANOVA) technique using MS-Stat computer package and means were separated by Duncan's new multiple range test (DMRT) at 5% level of significance.

3. Results and Discussion

Storage condition particularly temperature had a profound influence on seed germination and emergence of *dhaincha* seeds of all accessions (Table 1). The highest number of normal seedlings (76%) was recorded in G-13, while the lowest percentage (21.75%) was in G-20 when the seeds were stored in the refrigerator. The highest percentage of normal seedlings (69.50%) was recorded in G-5 and the lowest (21.50%) was in G-20 when the seeds were stored at room temperature. Seed emergence was 90% in G-11

and 30.75% in G-20 when the seeds were stored in the refrigerator. Emergence was 81.50% in G-05, while only 26.50% in G-20 when the seeds were stored at room temperature. Variations in emergence and seedling attributes among the accessions of *dhaincha* might be due to the genetic make-up of the respective accessions. There was a significant difference between the percentage of emergence and normal seedlings within the accessions stored in a refrigerated condition (Table 1). There was no significant difference in emergence percentage between G-11 and G-13, but the difference was significant in the percentage of normal seedlings. That kind of variation was not observed in seeds stored at room temperature. The highest emergence (%) of G-20 seeds was maintained up to two months from the date of withdrawal from the refrigerated condition as reported by Karim (2015). The results of this investigation regarding the effect of different storage conditions were in conformity with that of the earlier researchers (Dwivedi and Shukla, 1990; Alam *et al.*, 2010; Basavegowda *et al.*, 2010).

There was a significant difference in vigour index among the *dhaincha* accessions and under different storage conditions (Table 2). Vigour index was higher when seeds were stored in a refrigerator and was lower when the seeds stored at room temperature. The highest vigour index (2002) was recorded in G-11, while the lowest (494.8) in G-20 when the seeds were stored in the refrigerator (Table 2). Vigour index was 1448 in G-05 and 391.2 in G-20 when the seeds were stored at the room temperature. In the refrigerator, physiological activities of the seeds were supposed to reduce due to low temperature, which caused an enhanced seed longevity. The probable reason for the slow rate of reduction in germination and vigour in cold storage condition could be due to reduced rate of respiration and metabolic changes occurring in seeds (Das *et al.* 1998).

The highest percentage of healthy seeds (83%) was recorded in G-06 and G-08, and the lowest (50%) was in G-20, when the seeds were stored

in refrigerator. These two accessions, G-06 and G-08 also produced relatively low percentage of shriveled and small seeds in the refrigerated condition (Table 3). The highest percentage of healthy (81.75%) seeds was observed in G-11, while the poorest (47.50%) was in G-20 when the seeds were stored at room temperature. Accession G-20 produced the highest percentage of shriveled and small seeds in both refrigerated and room temperature conditions (Table 3).

Four fungal genera *viz.* *Aspergillus*, *Fusarium*, *Penicillium*, and *Rhizopus* were identified in the stored seeds of different accessions of *dhaincha* (Table 4). Among them, *Fusarium* and *Rhizopus* emerged as the most prevalent and damaging genera for stored *dhaincha* seeds. Legume seeds might be susceptible to these two fungal genera. Khalequzzaman (2004) reported from a study that 19.99% and 19.65% French bean seeds were infected by *Fusarium* spp. and *Rhizopus* sp., respectively. *Aspergillus* and *Penicillium* are mostly responsible for the deterioration of stored seed of rice, wheat, pulses, oil seeds and different vegetable crops as reported by Copeland (1976).

In all the cases, fungal incidence was higher when seeds were stored at room temperature. When the seeds were preserved in refrigerated condition, the incidence of *Fusarium* sp. and *Rhizopus* sp. ranged from 4% to 11% followed by *A. flavus* 1% to 4%, *Penicillium* sp. 0% to 3% and *A. niger* 0% to 2% (Table 4). On the contrary, when seeds were stored at room temperature the incidence of *Fusarium* sp. ranged from 7% to 14% followed by *Rhizopus* sp. 6% to 12%, *A. flavus* 2% to 5%, *Penicillium* sp. 0% to 4% and *A. niger* 0% to 3%. Christensen (1967) observed that freshly harvested durum wheat seeds stored at 25°C with 13.4-13.6% moisture for 493 days were slowly invaded by *A. halophilicus* and *A. restrictus*, though germination was not affected. However, when seeds were stored with a moisture content of 14.2-14.4%, population of storage fungi increased and germination percentage was decreased noticeably.

Table 1. Effect of storage condition on seed germination of different accessions of *dhaincha*

Storage Condition	Accession number	Emergence (%)	Normal seedlings (%)	Abnormal seedlings (%)	Dead seeds (%)	Un-germinated seeds (%)
Refrigerator	G-01	73.50 hi	60.50 ef	13.00 gh	12.15 h-j	15.00 jk
	G-02	75.05 gh	58.00 f-h	17.05 c	8.00 o	17.00 i
	G-03	60.00 pq	49.00 l-n	11.00 ij	15.00 de	25.00 e
	G-04	77.13 g	60.00 ef	17.13 c	10.11 m	13.00 lm
	G-05	81.13 f	71.13 b	10.00 jk	8.00 no	12.00 mn
	G-06	81.75 ef	62.25 de	19.50 b	5.00 qr	14.00 kl
	G-07	81.75 ef	71.75 b	10.00 jk	9.10mn	11.00 no
	G-08	83.75 d-f	63.50 d	20.25 b	6.00 pq	11.00 no
	G-09	84.71 c-e	69.50 b	15.21 d	7.00 op	9.00 pq
	G-10	86.50 b-d	66.25 c	20.25 b	5.00 qr	9.00 pq
	G-11	90.00 a	70.50 b	19.50 b	4.00 rs	6.00 r
	G-12	66.28 l-n	54.25 ij	12.02 hi	14.00 ef	20.00 h
	G-13	89.13 ab	76.00 a	13.13 gh	3.00 s	9.00 pq
	G-14	64.88 m-o	50.88 k-m	14.00 e-g	15.00 de	23.63 e-g
	G-15	87.50 a-c	75.50 a	12.00 hi	5.00 qr	8.00 q
	G-16	64.75 m-o	51.25 kl	13.50 fg	13.00 f-h	23.75 ef
	G-17	63.38 no	48.00 mn	15.38 d	14.00 ef	23.50 e-g
	G-18	73.31 hi	62.25 de	11.06 ij	11.00 kl	16.00 ij
	G-19	64.25 m-o	53.25 jk	11.00 ij	14.00 ef	22.00 g
	G-20	30.75 t	21.75 q	9.00 kl	29.13 a	41.25 b
Room Temperature	G-01	70.00 i-k	59.00 fg	11.00 ij	12.21 g-i	18.81 h
	G-02	65.50 m-o	44.00 o	21.50 a	15.25 d	20.00 h
	G-03	57.00 qr	47.00 n	10.00 jk	20.13 bc	23.00 fg
	G-04	56.40 r	42.00 op	14.40 d-f	15.00 de	29.00 d
	G-05	81.50 ef	69.50 b	12.00 hi	9.1 mn	10.00 op
	G-06	69.00 j-l	49.00 l-n	20.00 b	11.36 i-k	20.00 h
	G-07	67.75 k-m	50.00 l-n	17.75 c	13.16 f-h	19.38 h
	G-08	72.25 h-j	54.25 ij	18.00 c	12.00 h-k	16.00 ij
	G-09	73.00 hi	56.00 h-j	17.00 c	13.30 fg	14.00 kl
	G-10	72.00 h-j	57.00 g-i	15.00 de	15.00 de	13.00 lm
	G-11	70.13 i-k	50.00 l-n	20.13 b	14.00 ef	16.00 ij
	G-12	49.00 s	40.00 p	9.00 kl	20.42 bc	31.00 c
	G-13	77.00 g	55.00 ij	22.00 a	11.00 j-l	12.21 mn
	G-14	47.50 s	39.50 p	8.00 l	21.00 b	32.00 c
	G-15	75.00 gh	55.00 h-j	20.00 b	12.13 h-j	13.18 lm
	G-16	50.50 s	41.50 op	9.00 kl	21.00 b	28.00 d
	G-17	57.25 qr	51.25 kl	6.00 mn	14.00 ef	29.36 d
	G-18	65.00 m-o	50.00 n	15.00 de	11.00 j-l	24.00 ef
	G-19	62.13 op	56.00 h-j	6.13 m	14.00 ef	24.00 ef
	G-20	26.50 u	21.50 q	5.00 n	19.38 c	60.00 a
LSD _{0.05}		2.66	3.12	1.05	1.03	1.51
CV (%)		3.48	3.24	5.35	5.84	5.52

Table 2. Effect of storage condition on vigor index of different accessions of *dhaincha*

Storage condition	Accession number	Germination (%)	Average root length (cm)	Average shoot length (cm)	Vigour index
Refrigerator	G-01	60.50 ef	4.93 mn	13.19 bc	1323.00 f
	G-02	58.00 f-h	5.65 h-j	11.90 e-j	1316.00 f
	G-03	49.00 l-n	4.27 pq	11.40 h-l	939.80 o-q
	G-04	60.00 ef	3.90 rs	10.60 l-p	1116.00 kl
	G-05	71.13 b	5.86 hi	12.80 c-e	1493.00 cd
	G-06	62.25 de	4.25 pq	11.30 i-m	1260.00 f-h
	G-07	71.75 b	4.80 no	12.90 cd	1416.00 e
	G-08	63.50 d	5.95f-h	8.51 q	1200.00 h-j
	G-09	69.50 b	4.92mn	10.30 n-p	1278.00 fg
	G-10	66.25 c	5.90g-i	11.95 e-i	1535.00 bc
	G-11	70.50 b	7.54 c	14.70 a	2002.00 a
	G-12	54.25 ij	7.03 d	10.92 k-o	1185.00 i-k
	G-13	76.00 a	5.02 l-n	12.50 c-g	1542.00 bc
	G-14	50.88 k-m	8.60 a	12.72 c-f	1322.00 f
	G-15	75.50 a	5.80 h-j	12.30 c-h	1575.00 b
	G-16	51.25 kl	6.50 e	13.90 b	1306.00 f
	G-17	48.00 mn	6.24 ef	11.70 g-k	1130.00 j-l
	G-18	62.25 de	4.00 q	8.45 q	912.50 qr
	G-19	53.25 jk	6.50 e	12.00 d-i	1184.00 i-k
	G-20	21.75 q	4.00 q-s	12.50 c-g	494.80 t
Room Temperature	G-01	59.00 fg	4.50 p	13.05 c	1230.00 g-i
	G-02	44.00 o	5.60 ij	11.50 h-k	1111.00 l
	G-03	47.00 n	4.00 q-s	11.01 j-n	855.60 r
	G-04	42.00 op	3.69 s	9.77 p	755.40 s
	G-05	69.50 b	5.78 h-j	12.10 d-i	1448.00 de
	G-06	49.00 l-n	4.10 qr	10.30 n-p	993.60 n-p
	G-07	50.00 l-n	4.31 pq	11.90 e-j	1102.00 lm
	G-08	54.25 ij	5.25 kl	8.20 q	974.80 n-q
	G-09	56.00 h-j	4.15 qr	10.13 n-p	1042.00 mn
	G-10	57.00 g-i	5.50 jk	11.34 i-m	1212.00 g-i
	G-11	50.00 l-n	4.30 pq	10.10 op	1008.00 no
	G-12	40.00 p	6.90 d	10.50 m-p	852.60 r
	G-13	55.00 ij	4.56 op	11.90 e-j	1267.00 f-h
	G-14	39.50 p	8.10 b	11.80 f-k	930.40 pq
	G-15	55.00 h-j	5.20 lm	12.10 d-i	1306.00 f
	G-16	41.50 op	6.20 e-g	13.15 bc	986.80 n-p
	G-17	51.25 kl	5.95 f-h	11.56 h-k	1011.00 no
	G-18	50.00 n	3.85 rs	8.23 q	785.20 s
	G-19	56.00 h-j	6.25 ef	11.90 e-j	1125.00 kl
	G-20	21.50 q	3.90 rs	11.70 g-k	391.20 u
LSD _{0.05}		2.66	0.276	0.766	64.58
CV (%)		3.48	3.70	4.78	4.02

Table 3. Seed health status of the seeds of 20 accessions of *dhaincha* (dry inspection)

Storage Condition	Accession number	Healthy Seeds (%)	Shriveled Seeds (%)	Small Seeds (%)
Refrigerator	G-01	79.25 a-g	13.75 np	7.02 h-k
	G-02	72.50 k-n	21.25 d	6.25 kl
	G-03	78.75 a-h	13.75 n-p	7.50 hi
	G-04	74.50 h-m	16.75 jk	8.75 g
	G-05	80.50 a-e	13.25 o-q	6.25 kl
	G-06	83.00 a	10.00 v	7.00 h-k
	G-07	78.75 a-h	15.25 lm	6.00 l
	G-08	83.00 a	12.25 q-s	7.25 h-j
	G-09	79.50 a-f	11.50 r-u	9.00 g
	G-10	81.25 a-e	14.00 m-o	4.75 m
	G-11	82.50 ab	12.50 p-r	5.00 m
	G-12	70.25 m-o	20.25 de	9.50 fg
	G-13	81.50 a-d	11.00 s-v	7.50 hi
	G-14	73.75 j-n	19.00 e-g	7.25 h-j
	G-15	80.75 a-e	10.50 uv	8.75 g
	G-16	82.00 a-c	10.75 t-v	7.25 h-j
	G-17	70.25 m-o	12.50 p-r	17.25 a
	G-18	73.50 j-n	19.25 ef	7.25 h-j
	G-19	75.00 g-l	18.50 f-i	6.50 j-l
	G-20	50.00 pq	37.50 c	12.50 c
Room Temperature	G-01	77.50 c-j	15.75 kl	6.75 i-l
	G-02	52.25 p	39.00 b	8.75 g
	G-03	75.00 g-l	12.50 p-r	12.50 c
	G-04	70.00 no	12.50 p-r	17.50 a
	G-05	75.50 f-l	17.00 jk	7.50 hi
	G-06	74.00 i-n	17.25 ij	10.00 ef
	G-07	77.25 d-j	14.00 m-o	8.75 g
	G-08	80.00 a-e	15.00 l-n	5.00 m
	G-09	74.50 h-m	17.75 g-j	7.75 h
	G-10	79.00 a-g	14.00 m-o	7.00 h-k
	G-11	81.75 a-d	12.00 q-t	6.25 kl
	G-12	70.00 no	17.50 h-j	12.50 c
	G-13	80.00 a-e	13.75 n-p	6.25 kl
	G-14	70.50 m-o	15.75 kl	13.75 b
	G-15	78.25 b-i	18.75 f-h	3.00 n
	G-16	76.75 e-k	15.00 l-n	7.75 h
	G-17	67.50 o	21.25 d	11.50 d
	G-18	70.00 m-o	21.25 d	8.75 g
	G-19	72.25 l-n	17.25 ij	10.50 e
	G-20	47.50 q	41.25 a	8.75 g
LSD _{0.05}		3.74	1.21	0.748
CV (%)		3.59	5.08	6.30

Table 4. Effect of storage conditions on seedborne fungus infection of different accessions of *dhaincha*

Storage condition	Accession number	<i>Aspergillus flavus</i> (%)	<i>Aspergillus niger</i> (%)	<i>Fusarium</i> sp. (%)	<i>Penicillium</i> sp. (%)	<i>Rhizopus</i> sp. (%)
Refrigerator	G-01	2.00 d	0.00 d	6.00 j	0.00 e	4.00 i
	G-02	1.00 e	2.00 b	7.12 hi	2.00 c	7.00 f
	G-03	2.00 d	0.00 d	6.00 j	2.00 c	5.00 h
	G-04	2.00 d	2.00 b	6.00 j	0.00 e	6.00 g
	G-05	2.01 d	1.00 c	7.00 i	1.00 d	4.00 i
	G-06	2.00 d	1.00 c	8.00 gh	0.00 e	7.00 f
	G-07	3.00 c	2.00 b	5.00 k	2.00 c	5.00 h
	G-08	2.00 d	1.00 c	4.00 k	0.00 e	6.00 g
	G-09	3.00 c	0.00 d	7.00 i	2.00 c	8.00 e
	G-10	1.00 e	0.00 d	9.00 ef	2.00 c	9.00 d
	G-11	1.00 e	1.00 c	6.00 j	3.00 b	10.00 c
	G-12	3.08 c	1.00 c	8.25 fg	3.00 b	11.00 b
	G-13	1.00 e	0.00 d	9.00 ef	2.00 c	9.00 d
	G-14	1.00 e	1.00 c	11.10 c	1.00 d	8.00 e
	G-15	4.00 b	0.00 d	6.00 j	0.00 e	6.00 g
	G-16	4.00 b	1.00 c	5.00 k	1.00 d	7.00 f
	G-17	2.00 d	0.00 d	8.00 gh	1.00 d	8.00 e
	G-18	3.00 c	0.00 d	7.00 i	1.00 d	6.00 g
	G-19	2.00 d	0.00 d	5.00 k	3.00 b	9.00 d
	G-20	2.00 d	1.00 c	6.00 j	1.00 d	10.00 c
Room Temperature	G-01	5.00 a	0.00 d	9.25 de	1.00 d	8.00 e
	G-02	4.00 b	1.00 c	8.00 gh	1.00 d	10.00 c
	G-03	2.00 d	1.00 c	10.00 d	3.00 b	12.00 a
	G-04	4.02 b	2.00 b	12.00 b	2.00 c	11.00 b
	G-05	4.00 b	3.00 a	12.00 b	3.00 b	10.00 c
	G-06	3.00 c	1.00 c	11.00 c	1.00 d	12.00 a
	G-07	3.00 c	1.00 c	9.00 ef	0.00 e	11.00 b
	G-08	4.00 b	0.00 d	8.00 gh	2.00 c	9.00 d
	G-09	5.00 a	1.00 c	7.00 i	1.00 d	7.00 f
	G-10	3.00 c	0.00 d	11.00 c	2.00 c	6.00 g
	G-11	3.00 c	0.00 d	8.00 gh	3.00 b	9.00 d
	G-12	3.00 c	0.00 d	9.00 ef	3.00 b	10.00 c
	G-13	2.00 d	1.00 c	14.00 a	1.00 d	11.00 b
	G-14	2.00 d	1.00 c	12.00 b	2.00 c	12.00 a
	G-15	2.00 d	1.00 c	7.00 i	3.00 b	8.00 e
	G-16	5.00 a	1.00 c	8.00 gh	0.00 e	8.00 e
	G-17	4.00 b	2.00 b	10.00 d	2.00 c	9.00 d
	G-18	2.00 d	1.00 c	8.00 gh	1.00 d	10.00 c
	G-19	2.99 c	2.00 b	9.00 ef	4.00 a	8.00 e
	G-20	3.00 c	1.00 c	8.00 gh	2.00 c	9.00 d
LSD _{0.05}		0.290	1.17	0.798	0.230	0.597
CV (%)		7.64	10.14	6.98	10.31	5.09

4. Conclusions

From the findings of this study, it was concluded that the storage temperature played an important role in the maintenance of seed health and quality of *dhaincha* seeds. Fungi of the genera *Aspergillus*, *Fusarium*, *Rhizopus*, and *Penicillium* were associated with the seed quality of *dhaincha* seeds. The genotypic difference in seed quality of *Sesbania* spp. is conspicuous under different storage temperature conditions.

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