

Research paper

**Predicting the Longevity of Sesame Seeds under Short-Term Containerized Storage
with Charcoal Desiccant**

Abstract

Seeds are characterized by rapid deterioration during storage under humid tropical conditions of high air temperature and relative humidity. Physiological changes that occur in seeds during storage are manifested as reduction in seedling vigor index, number of germination, percentage germination, speed of germination and rate of germination among others. This study aimed at prolonging the longevity of sesame seed through containerized storage with charcoal desiccant. Forty grams of sesame seeds was stored with varying amount of charcoal desiccant (40g, 80g, 120g, 160g, 200g and an untreated control). The containerized seeds were then placed in a wooden cabinet with average ambient conditions of 29.8°C and 80% relative humidity, and stored for 12 weeks. Samples were taken from storage at interval of two weeks and tested for seed viability and seedling vigor. Analysis of variance (ANOVA) was carried out on the data collected and treatment means were separated using Duncan's Multiple Range Test (DMRT). Serial germination data were also subjected to probit analysis in order to model sesame seed deterioration in storage. ANOVA results show that charcoal treatments were highly significant ($P \leq 0.01$) on all the seed viability and seedling vigour parameters evaluated. Storage time was also highly significant on all the parameters. However, interaction between seed treatment and storage time was not significant ($P \geq 0.01$) on seed germination and seedling vigour index. There were also statistical differences among the charcoal treatments and among the storage periods. Probit results indicate that seed preservation was optimal in seed treated with 200g charcoal with seed half life (P_{50}) of 13.19 weeks, and lowest seed deterioration rate ($1/\sigma$) of 0.1559. It is recommended that 200g or more of dry charcoal should be adopted for short-term and medium-term sesame seed treatment as it effectively maintained seed viability and seedling vigor during storage as compared to other treatments.

Keywords: Seed treatment and storage, Seed viability, Seedling vigour, Seed deterioration.

1.0 Introduction

Seed deterioration starts immediately after a crop has attained the physiological maturity stage. In a crop seed like sesame (*Sesamum indicum*, L.) deterioration is even

38 faster immediately after harvest from the field; this is owing to its high oil content and
39 fast cellular respiration occurring in the seed (Oyekale *et al.*, 2012). Several methods are
40 being adopted therefore to encourage crop/seed shelf (storage) life while preserving it;
41 and these may include: seed treatment with suitable chemicals or plant products, as well
42 as seed storage in safe containers (Abdul-Baki and Anderson, 1973). Roberts (1972)
43 reported that seed deterioration during storage was due to the damage in cell membrane
44 and other chemical changes in the seed system such as the protein and nucleic acid
45 accumulation. Such degenerative changes result in complete disorganization of
46 membranes and cell organelles and ultimately causing death of the seed and loss of
47 viability. Villiers (1980) opined that the most common and consistent ultra-structural
48 changes in all the cell organelles was the loss in integrity of membranes, which invariably
49 leads to increased seed deterioration especially during storage.

50 The storability of seeds is also influenced by the type of packaging material.
51 Seeds stored in moisture-proof sealed containers provide suitable environment for
52 storage, offer protection against contamination and also acts as a barrier against the
53 escape of seed treatment chemicals than in moisture pervious containers (Nagaveni,
54 2005). Miyagi (1966) dried seeds of onion, carrot, cabbage, cucumber and tomato in
55 desiccators and stored in moisture vapour-proof resistant and impervious containers.
56 Higher viability and vigour was retained for longer period in moisture-proof containers
57 followed by moisture resistant and impervious containers respectively.

58 In the tropics where the temperature can be as high as 33°C and relative humidity
59 of about 80%, seeds deteriorate rapidly under the prevailing high temperature and relative
60 humidity (Daniel and Ajala, 2004). Harrington (1960) reported that for every one percent

61 moisture decline and for each 5°C decrease in temperature the storage period will be
 62 doubled. In open and pervious container, seed moisture content is determined by RH of
 63 the surrounding atmosphere and temperature of the storage environment. Robert (1961)
 64 also opined that seed stored in ambient conditions loose their viability and vigour very
 65 fast due to change in environmental conditions.

66 Seeds begin to deteriorate as soon as they are harvested or collected. Depending
 67 on ambient temperature and humidity, there is a risk that they will be dead by the time
 68 they are needed for planting (Harrington, 1970). If more than 50% of the seeds have
 69 already died, potentially important characteristics will have been lost. Harrington (1970)
 70 also said if a particular seed lot/seed collection will remain alive, and therefore usable,
 71 then the following have to be put into consideration:

- 72 • Seed moisture content - seeds stored in open storage in humid conditions will
 73 have high moisture levels and will not live as long as collections that have been
 74 properly dried and stored in sealed containers or those stored under dry
 75 conditions.
- 76 • Storage temperature - seeds stored at higher temperatures will not live as long as
 77 seeds stored under cooler conditions.
- 78 • Initial seed quality - seeds collected too early or too late will not live as long as
 79 seeds collected at the optimum stage.
- 80 • Species - some species are inherently short-lived.

81 The most important factor, and probably the easiest to control, is seed moisture content.
 82 Correct drying and packaging can make the difference between seeds surviving for a few

83 months at best to being a high quality resource available for use for many years, possibly
84 decades, into the future.

85 The preservation of orthodox seeds by cold storage helps in sustaining seed
86 viability; but the problem of poor electricity hampers this process because it raises the
87 cost of seed preservation. Harrington (1972) suggested that within the normal range of
88 moisture and temperature for stored seed, each 1% reduction in seed moisture content or
89 each 5°C reduction in temperature doubles storage life of the stored seed. Since sesame is
90 a small flat seed, it is difficult to move much air through it in a storage bin. Therefore, the
91 seeds need to be harvested as dry as possible and stored at 6 percent moisture or less. If
92 the seed is too moist, it can quickly heat up and become rancid (Oyekale *et al.*, 2012).
93 Environmental conditions which are safe for seed storage from harvest to planting are not
94 necessarily safe for longer periods. Controlled seed storage is thus very essential
95 especially in tropical and subtropical conditions in order to maintain seed viability and
96 seedling vigour for longer periods (Nagaveni, 2005).

97 Charcoal and other inexpensive potential desiccants have the capacity to dry seeds
98 when they themselves have been dried beforehand (this creates the water potential
99 difference between the desiccant and the seeds to be dried which drives the drying
100 process). Some traditional seed storage methods suggest placing a layer of charcoal on
101 top of seeds before sealing them for storage. This technique may help to deter insects.
102 However, dried charcoal and other desiccants such as dried rice can also be used to dry
103 seeds before storage. Charcoal and seeds such as rice or maize are readily available,
104 inexpensive potential desiccants that can be found in rural areas throughout the world.
105 The desiccant must be dry to start with, otherwise it will not be able to absorb much

moisture, and the seeds will not dry properly. Being black in colour, charcoal has the potential to absorb solar heat during the day thus causing it to dry below ambient humidity levels. Also, charcoal exposed to direct sun for about 5 hours will reach a very low moisture level and will have a lot of drying potential.

The major objective of this study is to estimate sesame seed longevity using improvised containerized dry storage at ambient conditions of the humid tropical environment.

The specific objectives are

1. To evaluate the effectiveness of containerized seed storage system.
2. To evaluate the efficacy of dry charcoal as seed storage desiccant.
3. To monitor and predict the seed viability and seedling vigour performances of sesame seed during low-tech. storage at ambient seed storage condition.

2.0 Materials and Methods

2.1 Seed, Seed Source and other Materials used

The crop seed used for this work was sesame (*Sesamun indicum*) INCRIBEN-01. The seed was collected from the National Center for Genetic Resources and Biotechnology (NACGRAB), Ibadan South west Nigeria. Other materials used are:

1. Plastic containers: for seed storage.
2. Dried charcoal: as drying or dehumidifying agent.
3. Oven: for drying the charcoal.
4. Desiccators; for cooling the oven-dried charcoal.
5. Sensitive weighing balance: for determining weights of charcoal and seed.

6. Petri dishes and filter paper: as growth medium for seed viability and vigour evaluation.

7. Thermohygrometer: for monitoring the temperature and relative humidity of the seed storage environment.

8. Wooden cabinet: it was used as seed storage facility.

2.2 Initial Seed Quality Evaluation

Petri dishes were dried for 4 hours and put in the desiccators for 1 hour in order to attain constant weight. Wet Filter paper was placed in the Petri dishes and 50 seeds of sesame crop were counted and sowed in triplicates. Seeds were then evaluated for percent seed germination, seedling length, seedling vigour index, speed of germination and rate of germination as follow:

Percent Seed Germination = $\frac{\text{no of seed germinated}}{\text{no of seed sowed}} \times 100$

Seedling vigour index (SVI) = $\text{percent seed germination} \times \text{seedling length}$.

Speed of germination (SOG) =

$$\frac{\text{no of seed at first count}}{\text{day of first count}} + \frac{\text{no of seed at second count}}{\text{day of second count}} + \frac{\text{no of seed at final count}}{\text{day of final count}}$$

(Adebisi and Oyekale, 2005)

Rate of germination = $1/t_n (\Sigma G_n)$ (Daniel, 2007)

where t_n = total time taken

ΣG_n = cumulative germination count.

The initial seed moisture content of the seed lot was determined by the modification of the gravimetric (forced air) oven method (ISTA, 1985); using the formula:

% Seed MC (fw. b) = $(M_2 - M_3) / (M_2 - M_1) \times 100$

154 Where, M1 = weight of Petri dish, M2 = weight of Petri dish plus fresh seeds, M3 =
155 weight of petri dish plus dried seeds.

156 ***2.3 Seed Treatment, Packaging and Storage***

157 The surface area of local charcoal was increased by breaking it into smaller
158 pieces, after which it was oven-dried for 4hrs. The dry sample was removed afterwards
159 and kept in desiccators for another 1hr to cool and return to constant weight. Forty (40)
160 grammes of sesame seed was also weighed and packed into six separate 2mm net bags
161 which were suspended in plastic containers (plate 1) with varying amounts of charcoal
162 desiccants (40g, 80g, 120g, 160g, 200g and 0g as control) (Plate 2). The seed treatments
163 are as follow:

164 40g Seed: 0g Charcoal (1:0)

165 40g Seed: 40g Charcoal (1:1)

166 40g Seed: 80g Charcoal (1:2)

167 40g Seed: 120g Charcoal (1:3)

168 40g Seed: 160g Charcoal (1:4)

169 40g Seed: 200 Charcoals (1:5)

170 Treated and containerized seeds were later stored in semi-sealed wooden cabinets for a
171 period of 12 weeks, during when seed viability, seedling vigour and seed moisture
172 content of sesame were evaluated. The containerized storage environment and the cabinet
173 environment were monitored with thermohygrometers (plates 3 and 4).

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176 Plate 1. Sesame seed separated inside storage container by 2mm fibre net.

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183 Plate 2. Sesame seed under containerized storage with charcoal desiccant.

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190 Plate 3. Containerized sesame arranged and stored under ambient condition of a wooden
 191 cabinet.

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Plate 4. Differential storage conditions (relative humidity) of the control and highest charcoal desiccant treatments of stored sesame seed.

2.4 *Seed Viability and Seedling Vigour Evaluation*

This was carried out as in the initial seed quality evaluation.

2.5 *Statistical Analyses*

Data collected from this experiment were analyzed using SAS (Statistical Analysis System) version 9.0 (SAS, 1999). Analysis of variance (ANOVA) was carried out; (where storage time and seed treatment are factors), in order to be able to determine if the seed storage time (periods) and the seed treatments were significant on the parameters evaluated. Means from ANOVA were separated using Duncan's Multiple Range Test (DMRT), to be able to detect differences among treatments. Probit analysis was also carried out on the serial germination data; to model seed deterioration in storage. Parameters estimated are: Seed half-life (P_{50}), Probit value of the initial seed quality (K_i), Rate of seed deterioration ($1/\delta$) and Standard deviation of time to seed death (δ).

3.0 *Results and Discussion*

3.1 *Effect of Seed Treatment and Storage Period on Seed Viability and Seedling Vigour of Stored Sesame Seeds*

Means square from analysis of variance of seed viability and seedling vigour variables are presented in Table 1. Treatment and storage time are highly significant ($P \leq 0.01$) on all the parameters (Nogerm-number of germination, Pergerm-percent germinated, SVI-seedling vigor index, ROG-rate of germination, SOG-speed of germination) evaluated. The interaction effect of treatment and storage time was not however significant ($P \geq 0.05$) on number of germinated seeds, percent germination and seedling vigour index, but highly significant on speed of germination and rate of germination. This is in line with the works of Nagaveni (2005), Ejeromedoghene (2010)

226 and Akinkuotu (2012), who reported that interaction between storage time and seed
227 treatment were highly significant on seed viability and seedling vigour attributes.

228

229 Table 1: Means square from analysis of variance of charcoal treated sesame seeds stored
230 for 12 weeks under ambient storage condition.

Variables	Df	No Germ	% Germ	SVI	SOG	ROG
SOV						
Trt	5	152.34**	614.66**	16904.50**	1.39**	1.38**
Time	4	1630.71**	6462.11**	58038.31**	40.07**	20.80**
Trt*Time	20	14.47 ^{ns}	57.52 ^{ns}	4625.52 ^{ns}	0.62**	0.87**
Error	60	11.41	46.53	2467.46	0.27	0.39
Total	89					

231 Key

232 *: significant at 5% level of probability

233 **: significant at 1% level of probability

234 ns: Not significant

235 df : Degree of freedom

236 SOV : sources of variation

237 No Germ : number of germinated seed

238 % Germ: percentage germination

239 SOG: speed of germination

240 ROG: rate of germination

241 SVI: seedling vigour index

242 Trt: treatment.

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3.2 Mean Performances of Seed Viability and Seedling Vigour Variables of Stored

Sesame Seeds under Six Dry Charcoal Treatments

Means of seed viability and seedling vigour variables for six charcoal desiccant treatments of sesame seeds stored for 12 weeks under ambient condition are presented in Table 2. There were no significant differences in all the treatments (0g, 40g, 80g, 120g and 160g) for all the variables evaluated except in 200g which had highest significant performances for the seed viability and seedling vigour parameters evaluated. This is similar to the work of Usha *et al.* 1990, Akinkuotu, 2012, Ejeromedoghene, 2010 and Singh and Dadlani, 2003, who recorded significantly higher seed germination for stored sesame and soyabean seeds under low-cost storage conditions.

Means of seed viability and seedling vigor variables of sesame seed stored for 12 weeks are presented in Table 3. The results show that differences were noticed across the storage periods (3wks, 6wks, 8wks, 10wks and 12wks) for all the parameters evaluated except in a few situations. Seedling vigour index was not different at 10wks (142.85c) and 12wks (128.90c). Also, speed of Germination (SOG) was not different at 3wks (2.99b) and 8wks (3.04b). This was also the same at 6wks and 12wks for rate of germination (ROG), in which results were not different. This result is in contrast with what Gupta *et al.* (1989) reported on similar works.

275 Table 2: Means of Viability and Vigour Variables for Six Charcoal Desiccant Treatment
276 of Sesame Seeds Stored for 12 Weeks Under Ambient Condition.

Variables Treatments(gm)	No Germ	% Germ	SVI	SOG	ROG
0	32.80 ^b	65.47 ^b	189.07 ^b	3.27 ^b	4.31 ^b
40	30.40 ^b	60.80 ^b	181.41 ^b	3.16 ^b	4.23 ^b
80	31.13 ^b	62.00 ^b	197.27 ^b	3.27 ^b	4.07 ^b
120	32.87 ^b	65.73 ^b	165.10 ^b	3.03 ^b	4.23 ^b
160	30.47 ^b	60.93 ^b	176.87 ^b	3.50 ^b	3.98 ^b
200	38.87 ^a	77.73 ^a	259.71 ^a	3.89 ^a	4.85 ^a

277

278 Key

279 Means with the same letter are not significantly different

280 No Germ : number of germinated seed

281 % Germ : percentage germination

282 ROG : rate of germination

283 SVI: seedling vigour index

284 SOG: speed of germination

285

286 Table 3: Means of viability and vigor variables of sesame seeds stored for 12 weeks
287 under ambient storage condition.

Variables Time (weeks)	No Germ	% Germ	SVI	SOG	ROG
3	42.94 ^a	85.56 ^a	256.86 ^a	2.99 ^b	6.13 ^a
8	39.06 ^b	78.11 ^b	237.44 ^{ab}	3.04 ^b	5.58 ^b
6	35.67 ^c	71.33 ^c	208.48 ^b	5.25 ^a	3.10 ^d
10	26.39 ^d	52.78 ^d	142.85 ^c	2.62 ^b	3.77 ^c
12	19.72 ^e	39.44 ^e	128.90 ^c	2.82 ^b	2.82 ^d

288

289 Key

290 Means with the same letter are not significantly different.

291 NoGerm :Number of Germinated seed

292 %Germ :Percentage Germination

293 SVI: seedling vigour index

294 SOG: speed of germination

295 ROG: rate of germination

296

297 Table4 shows means of viability and vigour variables evaluated for sesame seeds
298 under six dry-charcoal treatments during 12-week storage period. For the untreated
299 control (Og charcoal), mean seed viability and seedling vigour values were statistically

different across the storage periods; with significantly highest number of germination (49.00a), germination percent (89.33a) and rate of germination (6.28a) recorded at 3 weeks. For charcoal treatment at 40g, SVI and ROG did not show any difference at 10 and 12 weeks; while SVI performance for this treatment was also significantly highest (278.45a) at 3 weeks, but lowest (95.09c) at 12 weeks of storage. Mean performances of 200g dry charcoal treatment for all the seed viability and seedling vigour variables were significantly different across the storage periods. However, SVI and ROG were significantly highest (300.53a and 6.48a respectively) at 8 weeks under 200g treatment. Though there was disparity in results of mean seed viability and seedling vigour observed across charcoal treatments and seed storage time, but the significantly highest seedling vigour performance (SVI) for treatment X time interaction was obtained with 200g charcoal treatment and at 8 weeks of seed storage (300.53). These results indicate that the more the quantity of dried charcoal used for the sesame seed storage the more conducive the storage environment; thus prolonging and preserving the agronomic qualities of the crop seed. Similar results were also reported by Oyekale *et al.* (2012), Ejeromedoghene (2010) and Akinkuotu (2012), who argued that seed viability and seedling vigour of seeds in storage are maintained with moisture manipulation of the storage environment.

Table 4: Means of viability and vigour variables evaluated for sesame seeds in containerized charcoal treatment under ambient seed storage condition.

Variables	Time(wks)	NoGerm	%germ	SVI	ROG	SOG
Trt						
0	3	45.00 ^a	89.33 ^a	268.73 ^a	6.28 ^a	2.59 ^b
0	6	35.00 ^b	70.00 ^b	221.87 ^a	3.27 ^b	5.95 ^a
0	8	38.00 ^{ab}	76.00 ^{ab}	236.61 ^a	5.43 ^a	3.13 ^b
0	10	25.33 ^c	50.67 ^c	110.35 ^b	3.62 ^b	2.18 ^b
0	12	20.67 ^c	41.33 ^c	107.80 ^b	2.95 ^b	2.50 ^b
40	3	38.33 ^a	76.67 ^a	278.45 ^a	6.14 ^a	3.09 ^b
40	6	32.66 ^a	65.33 ^a	196.59 ^b	3.47 ^{cb}	4.67 ^a
40	8	36.00 ^a	72.00 ^a	212.83 ^b	5.14 ^b	2.94 ^b

40	10	26.00 ^b	52.00 ^b	124.08 ^c	3.71 ^c	2.57 ^b
40	12	19.00 ^c	38.00 ^c	95.09 ^c	2.71 ^d	2.52 ^b
80	3	41.00 ^a	80.67 ^a	285.67 ^a	5.57 ^a	3.50 ^b
80	6	36.33 ^a	72.67 ^a	263.03 ^a	3.59 ^b	5.19 ^a
80	8	38.67 ^a	77.33 ^a	220.37 ^{ab}	5.51 ^a	2.84 ^{bc}
80	10	23.00 ^b	46.00 ^b	130.00 ^{bc}	3.29 ^{bc}	2.35 ^c
80	12	16.67 ^c	33.33 ^c	87.31 ^c	2.38 ^c	2.46 ^c
120	3	42.67 ^a	46.00 ^a	239.49 ^a	6.19 ^a	3.35 ^b
120	6	33.67 ^{bc}	33.33 ^{bc}	158.51 ^{ab}	2.40 ^c	4.81 ^a
120	8	40.00 ^{ab}	85.33 ^{ab}	197.19 ^a	5.71 ^a	2.44 ^{bc}
120	10	27.33 ^{cd}	67.33 ^{cd}	146.71 ^{ab}	3.90 ^b	2.67 ^{bc}
120	12	20.67 ^d	80.00 ^d	83.59 ^b	2.95 ^c	1.89 ^c
160	3	45.00 ^a	90.00 ^a	217.00 ^{ab}	6.52 ^a	2.45 ^b
160	6	33.67 ^b	67.33 ^b	179.00 ^{bc}	2.87 ^c	4.81 ^a
160	8	36.33 ^b	72.67 ^b	257.08 ^a	5.18 ^b	3.55 ^{ab}
160	10	20.67 ^c	41.33 ^c	128.24 ^{cd}	2.95 ^c	2.98 ^b
160	12	16.67 ^c	33.33 ^c	103.05 ^d	2.38 ^c	3.72 ^{ab}
200	3	45.67 ^a	91.33 ^a	251.99 ^a	6.10 ^b	2.75 ^c
200	6	42.67 ^a	85.33 ^a	231.91 ^a	3.00 ^c	6.10 ^a
200	8	45.33 ^a	90.67 ^a	300.53 ^a	6.48 ^a	3.37 ^{bc}
200	10	36.00 ^b	72.00 ^b	217.75 ^a	5.14 ^b	2.97 ^c
200	12	24.67 ^c	49.33 ^c	296.56 ^a	3.52 ^c	4.23 ^b

Key

Means with the same letter along the columns are not significantly different.

Trt: charcoal treatments

NoGerm: number of germinated seed

%Germ: percentage germination

SVI: seedling vigour index

SOG: speed of germination

ROG: rate of germination

3.3 Estimates of Probit Viability

Results from assessment of probit longevity for sesame seed stored under various seed desiccant ratios are presented in Table 5. The parameters estimated were K_i (Probit value of initial seed viability), $1/\sigma$ (Measure of seed deterioration in storage), σ =Standard deviation of seed death in storage) and P_{50} (Seed half-life or measure of time to 50% seed viability in storage). The highest K_i value (2.09) was recorded in 200g treatment; while rate of seed deterioration ($1/\sigma$) was highest (-0.1852) in 160g treatment. Seed storage life (half-life) was however longest (13.19weeks) longest in seeds treated with 200g dry charcoal. This result agrees with what Ejeromedoghene (2010), who evaluated and modeled the storability of soyabean seed using dried charcoal observed. In fact, the initial quality of the seed before storage as indicated by the K_i value is a pre-requisite for the seed storability.

Table 5: Estimates of probit longevity for sesame seed stored with dried charcoal at various seed desiccant ratios.

Probit parameters	Intercept (K_i)	Slope ($1/\sigma$)	Sigma (σ)	Half-life (P_{50})
Trts(gramme)				
0	1.69	-0.1588	6.30	10.66
40	1.14	-0.1095	9.14	10.45
80	1.57	-0.1559	6.41	10.04
120	1.47	-0.1317	7.59	11.14
160	1.77	-0.1852	5.40	9.58
200	2.09	- 0.1586	6.31	13.19

Key

Trts = Charcoal treatments

K_i = Probit value of initial seed viability

$1/\sigma$ =Measure of seed deterioration in storage

σ =Standard deviation of seed death in storage

P_{50} =Seed half-life or measure of time to 50%

seed viability in storage.

3.4 Seed Moisture Trend in Stored Sesame Seed

The seed moisture changes in stored sesame seeds under varying amounts of charcoal desiccant are presented in Figure 1. At 3wks, 160g charcoal treatment has the highest moisture percent (4.5%), followed by 40g (4.3%), 80g and 120g (4%). The lowest moisture regime is however recorded for 200g charcoal treatment (3%). At 6 weeks, the highest was observed in 80g treatment (5.9%), followed by 120g (4.5%), 40g (4%), 0g (3.1%), 200g (3%) and 160g (2.2%). At 8 weeks, 40g charcoal treatment has the highest moisture regime (4.5%), with the lowest observed in the control treatment. At 10 weeks, moisture was highest in 200g (3.9%) and lowest in 120g (2.7%) charcoal treatment. Also at 12 weeks after storage, moisture was highest in 40g (4.9%) and lowest in 120g (2.9%). The moisture trend thus shows that sesame seeds stored with 200g dry charcoal already had their moisture reduced to 3% by the end of first 3 weeks and this was maintained at around the same point even at 12 weeks. This of course would have been occasioned by the drier storage environment created by higher volume of the dried charcoal used (200g). This result is in line with the work of Ejeromedoghene (2010), who reported that seeds stored under higher seed : desiccant ratios had significantly reduced moisture content throughout storage period, and also had their viability and vigour better maintained than those stored with reduced quantity of charcoal desiccant. Therefore, the storage life of seeds stored under moisture-controlled environment is usually longer than seeds stored under ambient storage conditions; and seed deterioration is often faster in the later (Oyekale, 2010).

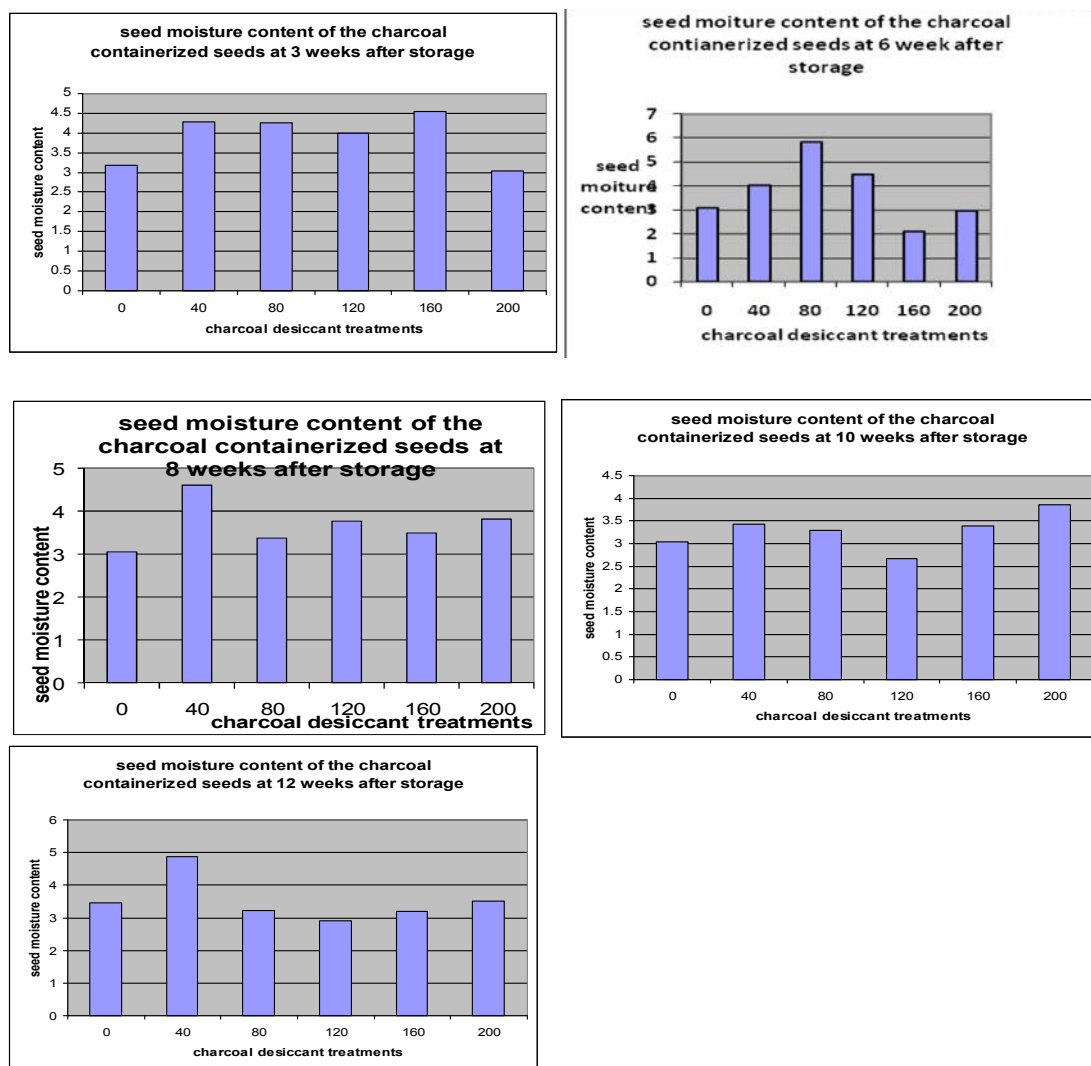


Fig. 1. Seed moisture trends of five charcoal desiccant treatments during 12 weeks storage period.

4.0 Conclusion

Among the charcoal desiccant treatments, 200g was recorded as enhancing highest seed viability and seedling vigour throughout the 12-week storage period. Based on the result of this study, it may be concluded that sesame seed stored with high quantity of dry charcoal (200g or more) can maintain seed quality for up to 13 x 2wks. It should be noted therefore that dry charcoal as a type of seed storage desiccant is an effective tool

in safe seed storage and should be adopted as a low-cost seed storage desiccant technology, especially for oil crops for short and medium term seed storage. However, in storing sesame seed consideration should be given to the initial quality of the variety in question; because better initial quality may likely guarantee longer storability and longevity of the seed.

5.0 References

Abdul-Baki, A. A., and Anderson, J. D. (1973). Physiological and biochemical deterioration of seed. In *Seed Biology* (II Ed): Kozlowski, T. T., Academic Press, New York, London, pp. 283-315.

Adebisi, M. A., and Oyekale, K. O. (2005). Effect of Seed Treatments and Storage Containers on the Maintenance of Viability of Okro Seed. *ASSET Series A.*, 5(1), 81-89.

Akinkuotu, A. O. (2012). Comparative effect of organic and inorganic seed treatments on Viability and vigour of sesame seeds in storage. B. Agric. Project report. Department of Agronomy and Landscape Design, Babcock University, Ilishan-Remo Nigeria, 52pp.

Daniel, I. O. (2007). Longevity of maize seeds during low input storage under ambient condition in South-western Nigeria. *Journal of Tropical Agriculture* 45(1-2): 42-45.

Daniel, I. O. and Ajala, M. O. (2004). Probit modeling of seed physiological deterioration in humid tropical seed stores. *ASSET A* 4(3): 47-53.

Ejeromedoghene, E. T. (2010). Physiological quality of soyabean seeds during containerized dry storage using dry charcoal. B. Agric. Project Report. Department of Plant Breeding and Seed Technology, Federal University of Agriculture, Abeokuta

- 416 Nigeria. 27pp.
- 417 Gupta, R. P., Ushamehra, Pandey, U. B. and Mehra, U. (1989). Effect of various
418 chemicals on viability of onion seed in storage. *Seed Research*, 17 (1): 99-101.
- 419 Harrington, J. F. (1960). Seed storage viability. Boyce Thompson Institute of Plant
420 Research, 17: 87-103.
- 421 Harrington, J. F. (1970). Seed and pollen storage for conservation of plant gene
422 resources. In *Genetic resources in plants: Their exploration and conservation*, (eds.
423 O.H. Frankel, and E. Bennet), pp. 501–521, Blackwell, Oxford.
- 424 Harrington, J. F. (1972). Seed storage and longevity. In: T.T. Kozlowki (ed.) *Seed*
425 *Biology*: Pp. 145-240. Academy Press inc. London.
- 426 ISTA, (1985). International rules for seed testing. *Seed Sci. Technol.*, 13: 307-355.
- 427 Miyagi, K. (1966). Effect of moisture proof packing on maintenance of viability of
428 vegetable seeds. Proceedings of International Seed Testing Association, 31: 213-220.
- 429 Nagaveni, P. K. (2005). Effect of storage conditions, packing material and seed treatment
430 on viability and vigour of onion seeds. M.Sc. (Agri.) Thesis, University of
431 Agricultural Sciences, Dharwad.
- 432 Oyekale, K. O. (2010). Modeling seed deterioration of maize under moisture-conditioned
433 and open storage in humid tropical seed stores. Ph.D Thesis. Department of Plant
434 Breeding and Seed Technology, University of Agriculture, Abeokuta Nigeria.
435 110pp.
- 436 Oyekale, K. O.; Nwangburuka, C. C.; Denton, O. A. Daramola, D. S.; Adeyeye, J. A. and
437 Akinkuotu, A. O. (2012). Comparative Effects of Organic and Inorganic Seed
438 Treatments on the Viability and Vigour of Sesame Seeds in storage. *Journal of*

- 439 *Agricultural Science* (JAS), Vol. 4 No. 9: 187-195. September 2012. Canadian
440 Center of Science and Education.
- 441 Robert, E. H. (1961). Viability of cereal seeds for brief and extended period. Seed
442 research. *Ann. Bot.* 25:373-380.
- 443 Roberts, E. H. (1972). Cytological, genetic and metabolic changes associated with loss of
444 viability. pp. 253-306. In E. H. Roberts (ed.). *Viability of seeds*. Chapman and Hall
445 limited, London.
- 446 SAS. (1999). Statistical Analysis Software (SAS). Systems for windows. SAS Users'
447 Guide; Statistics, Version 9.1. SAS Institute Inc. Cary. NC, USA. 1028pp.
- 448 Singh, K. K. and Dadlani, M. (2003). Effect of packaging on vigor and viability of
449 soybean (*Glycine max* (L.) Merrill) seed during ambient storage. *Seed Res.*, 31 (1):
450 27- 32.
- 451 Usha, H., Javaregowda, S. and Ramaiah, H. (1990). Influence of containers, chemicals
452 and byproduct treatments on storability of cowpea (*Vigna unguiculata*) and
453 horsegram (*Delieos bifloera*) seeds. *Leg. Res.*, 13 (1): 13-16.
- 454 Villiers, T. A. (1980). Ageing and the longevity of seeds on field conditions. *Seed Eco.*,
455 pp. 265-287.
- 456