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EFFECTS OF STORAGE CONDITIONS AND SEED SCARIFICATION ON SEED GERMINABILITY OF FIVE MULTIPURPOSE TREE SEEDS

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ABSTRACT

The study was conducted at University of Agriculture, Abeokuta, Ogun State, Nigeria. A total of 6750 seeds of five pasture legume species each, were stored under five storage conditions: refrigerator: deep freezer; wooden box with silica gel; earthen pot and unstored for 9 months. Seeds were sampled at of 30 days interval. They were scarified with concentrated sulphuric acid, sand paper, hot water at 60^{o}C for 10 minutes, hot water at 100^{o}C for less than one minute and the unscarified (control). After scarification, 10 (ten) seeds of each legume species under different storage conditions were placed on moistened cotton wool in petri dishes under laboratory condition for germination. The experiment was 5x5x9 factorial arrangement (legume species. storage conditions and storage periods) replicated three times. The data collected at monthly interval were subjected to General Linear Model of Minitab (1999). The results of this experiment showed that the highest germination was recorded in seeds stored in earthen pot (74.91%) followed by seeds stored in deep freezer (48.47%). The unstored seeds had the least germination (10.74%). With the earthen pot, germination was highest from *Albizia saman* (AS) seeds (87.63%), when *Enterolobium cyclocarpum* (EC) seeds had 84.49% with *Telphrosia bracteolata* (TB) having the least germination of 17.26%. Also, the highest germination was in hot water treatment at 60^{0}C (41.48%) which was closely followed by seeds treated with sand paper (40.74%) while untreated seeds (control) had the least germination percentage. In conclusion, forage legume seeds are better stored in cool environment with the earthen pot creating a cool and natural environment with no fluctuation in electricity. Using hot water at 60^{0}C and mechanical scarification with sandpaper having similar percentage germination of seeds. Storing seeds for six to seven months had the highest germinations of seeds.

Keywords: Seed germination, multipurpose tree seeds, seed storage, seed treatment

INTRODUCTION

Pasture establishment becomes successful when good quality seeds receive the right conditions to sprout and grow. Seeds are important as they possess production, consumption, and cultural value etc. Seeds are the most important input as it determines the upper limit of most important yield po-

tential and therefore the ultimate efficacy of other inputs (Delouche and Potts, 1983). Where fruiting is regular and abundant every year, it may be more cost efficient to collect surplus seeds to cover several years rather than to undertake collection every year. Hence, stored seeds serves as a buffer between demand and production and has a regular turnover. Seeds are stored during periods of seed availability and transferred to nurseries or other recipients when required to raise plants. In nature, seeds overcome two major problems for the plant; they provide a method by which a plant can multiply; they are means by which plants can survive adverse conditions (Fenwick, 1988).

The period of storage is limited by the technical and physiological storage potential that is the length of time seeds of particular species will survive under the available storage condition. To maintain viability over a prolonged period, it is important that the optional storage environment for the species is met, as far as possible. The speed at which seeds lose viability and vigor depends on several factors, which may include initial seed quality; storage conditions; seed treatments, presence of microorganisms and insects (Jolaosho *et al*., 2006; Ranganathan and Groot, 2023). Seeds can be stored to ensure the supply of good quality seed for a planting programme whenever needed (Wang, 1975; Jolaosho *et al*. 2006).

The conditions of seed storage environment are seldom optimal. Many unfavourable factors endanger seed quality. Earlier reports have shown that storage conditions and differences in genotype were all factors that might influence the maintenance of seed viability and vigor (Adebisi, 2001). In general viability of seed is retained best under conditions in which their metabolic activities are greatly reduced. Such conditions are as under low temperature condition and high Carbondioxide concentration. Seeds are found to lose viability during storage. The rate at which this occurs depends to a large extent, on the seed moisture content. High moisture content levels increase the life processes in seed and therefore, result in rapid ageing and loss of viability.

Seed germination occurs when a viable seed undergoes a process by which an organism grows from the seed. This is the sprouting of seedling from a seed of an angiosperm or gymnosperm. The rate of germination describes how many seeds of a particular plant or seed lot sprouts or germinates over a period expressed as a percentage. The germination rate can be used for calculating the quantity of seeds required in a given area (Penfield, 2017).

Harvesting of the seed at the optimum stage of seed development, with natural or artificial drying and dry storage condition are important preconditions for good quality seed supply (Harrington, 1972). The importance of moisture in seed storage is illustrated by Harrington (1972) rule of thumb that the life of seed is doubled by a 1% reduction of the seed moisture content. Delouche *et al.* (1973) regarded this convenient rule of thumb to be substantially correct for many seeds over a range of 6-16% moisture content. Since seeds must be kept for long period, there is need to determine the effects of storing seeds for more than six months under different conditions and the seed treatment appropriate for seeds of multipurpose trees. Therefore, the aim of this experiment was to determine the effects of seed storage length; environmental condition and seed scarification method on the germination of seeds of

five (5) leguminous plants.

MATERIALS AND METHODS

Experimental site

The experiment was carried out in the Laboratory of Pasture and Range Management, College of Animal Science and Livestock Production, University of Agriculture, Abeokuta, located on latitude 7°13' 49.46"N and longitude 3° 26'11.98" E (Google Earth, 2006) between March 2009 and January 2010.

Seed Collection and processing

Five legume seeds namely: *Albizia saman, Albizia lebbeck, Leucaenea leacocephala, Enterolobium cyclocarpum* and *Tephrosia bracteolata* were used. The pods of these plants were collected within the University of Agriculture, Abeokuta (UNAAB) between February and March 2009. The seeds were removed from the pods and stored immediately after harvesting under 5 different conditions.

Seed Storage Methods

Seeds of each legume were divided into five lots packed inside transparent nylon of small packs containing 30 seeds each to form a total of 1,350 seeds per storage condition for a storage period of nine months. The packaged seed samples were subjected to five different storage conditions namely: Deep freezer (5^0C), refrigerator (15^0C), wooden box in the seed processing laboratory (37^0C), earthen pot (30^0C) and jute bags on the floor in the seed processing laboratory (37^0C). The packaged seeds were stored under these conditions for as long as 9 months. Small packs of 30 seeds were taken from each storage condition for seed germination tests at 30 days interval during the time of storage.

Seed Scarification

At withdrawal from storage, seeds of each forage legume were scarified using diverse methods: concentrated Sulphuric acid; soaking in hot water at 60°C for 10 minutes; dipping in hot water 100°C with immediate withdrawer; Mechanical (sandpaper) and control (unscarified).

Concentrated Sulphuric Acid (CSA): Seeds were soaked in CSA for five minutes, follow by thorough washing and drying.

Hot water I: This treatment was achieved by soaking seed samples in hot water at 60°C for 10 minutes, there after seeds were left to cool. (Jolaosho *et al.,* 2006)

Hot water II: This treatment was achieved by placing seed sample in a handkerchief and placed inside hot water at 100°C and removed immediately; thereafter, seeds were left to cool.

Mechanical: This was carried out by rubbing the seed coat with sand paper

Control: Seeds were left unscarified or untreated.

Germination Test

After storage under different conditions, pack of 30 seeds each were taken from each storage conditions for seed germination tests at 30 days interval. The seeds were then scarified and planted inside the Petri dishes containing moist cotton wool. Daily germination counts were taken until the number of germinated seeds were constant.

$$\% \text{ Germination} = \frac{\text{Number of seeds germinated} \times 100}{\text{Number of seeds sown}}$$

Experimental Design

The experiment was a 5x5x9 factorial arrangement with five storage conditions, five scarification methods and 9 months of storage. These amounted to 225 treatment combinations with three replicates. Total number of seeds used was 225 X 10 X 3 = 6750 seeds.

Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA) using general linear model of Minitab computer Package (Minitab, 1998). The treatments that were significantly different at 5% were separated using Duncan's multiple range test.

RESULTS

The storage condition had significant effects on the percentage germination of all seeds of leguminous multipurpose tree seeds. With storage condition, storage in earthen pot generally had the highest percentage germination (74.91%), while storage in deep freezer had an average of 48.47% germination. The unstored seeds had the least germination (14.76%). With the earthen pot, germination was highest from *A. saman* (87.63%), when *E. cyclocarpum* had 84.49%; *L. leucocephala* (80.65%); *A. lebbek* (74.37%); and *T. bracteolata* (47.40%). Although, next to the highest germination was seeds stored in the deep freezer with overall average germination of 48.47%. The unstored *Leuceana leucocephala* had least germination value (5.10%), followed by *Albizia lebbek* (11.11%), then *T. bracteolata* (17.26%) (Table 1). The seeds stored in earthen pots had the highest percentage germination for all the browse plants and it ranges from 47.40% to 87.63%. The percentage germination of seeds stored in earthen pots were generally higher than those stored in deep freezer which was the next highest percentage germination by 7% to 60% (Table 1).

There were significant differences in the percentage germination of the seeds with different scarification methods. With scarification, hot water at 60^0C generally had the highest average germination of 41.48% followed by mechanical scrapping with sandpaper (40.74%) with concentrated sulphuric acid for 5 minutes as the third (39.88%) germination. The overall average germination of seeds with different scarification methods ranging between 37.35% for seeds from the untreated control to 41.48% for seeds treated with hot water at 60^0C for 10 minutes (Table 1).

E. cyclocarpum when scarified with hot water at 60^0C for 10minutes had the highest germination percentage (51.85%) while unscarified had the least value (44.22%). The germination percentage trends of other seeds were similar to that observed with the *E. cyclocarpum* as related to the scarification effects on the germination of the seeds except seeds of *A. lebbeck* (35.70%) and *L. leucocephala* (28.44%) treated with acids having the least germination and in the case of *T. bracteolate*, sulphuric acid treatment had seeds with the highest germination (35.04%) and the untreated control had the least (25.11%) (Table 1).

The length of storage had significant effects ($P<0.05$) on percentage germination of forage legume. All the seeds that were used for the experiment had higher percentage germination after six months of storage in September except *T. bracteolata* which had best value at the second month of storage in May. The highest germination of *A. saman* was after seven months of storage in October and least value was at the second month of storage in May for all the seeds except *T. bracteolata* (Table 1).

Table 1: Main Effects of Storage Condition, Scarification Method and Length of Storage on Germination (%) of Forage Legume Seeds

	EC	AS	AL	LL	TB	MEAN
ACID	46.81^{ab}	53.04^{ab}	35.70^{b}	28.44^{b}	35.04^{a}	39.88^{AB}
HW at 60^{o}C	51.85^{a}	53.85^{ab}	39.70^{ab}	34.44^{a}	27.56^{b}	41.48^{A}
HW at 100^{o}C	45.03^{ab}	50.00^{b}	37.56^{ab}	33.11^{ab}	28.00^{ab}	38.74^{B}
MECHANICAL	48.14^{ab}	54.37^{a}	40.51^{a}	31.93^{ab}	28.74^{ab}	40.74^{A}
CONTROL	44.22^{b}	49.26^{b}	38.82^{ab}	29.33^{b}	25.11^{c}	37.35^{C}
P =	0.00	0.00	0.00	0.00	0.00	
LENGTH OF STORAGE						
1 month	47.47 ^{bc}	46.13 ^{cd}	39.87 ^{b}	34.80 ^{b}	29.20 ^{c}	39.85^{C}
2 months	35.87 ^{d}	31.47 ^{e}	29.47 ^{c}	12.67 ^{d}	42.27 ^{a}	30.35^{F}
3 months	42.40 ^{cd}	45.07 ^{d}	34.67 ^{ab}	36.80 ^{ab}	35.20 ^{b}	38.83^{CD}
4 months	52.27 ^{b}	54.27 ^{b}	39.73 ^{b}	25.20 ^{c}	35.33 ^{b}	41.36^{BC}
5 months	45.73 ^{bc}	43.60 ^{d}	29.73 ^{c}	27.60 ^{c}	16.00 ^{d}	32.53^{E}
6 months	61.47 ^{a}	65.00 ^{a}	53.20 ^{a}	40.80 ^{a}	18.53 ^{d}	47.80^{A}
7 months	49.07 ^{bc}	67.73 ^{a}	52.80 ^{a}	33.73 ^{b}	29.20 ^{c}	46.51^{A}
8 months	44.80 ^{bc}	52.40 ^{bc}	31.73 ^{c}	34.93 ^{b}	24.67 ^{c}	37.71^{D}
9 months	45.87 ^{bc}	62.67 ^{a}	34.93 ^{bc}	36.53 ^{ab}	29.60 ^{c}	41.92^{B}
P =	0.00	0.00	0.00	0.00	0.00	

^{abcd} means in each column with the same letter are not significantly different (P<0.05).

EC- *Enterolobium cyclocarpum,* AS- *Albizia saman, AL- Albizia lebbeck,* LL- *Leucaena leucocephala,* TB- *Tephrosia bracteolate*

The interactive effects of storage conditions and scarification had significant effects (P<0.05) on percentage germination of pasture seeds. The percentage germination of seeds of *A. saman* stored under different storage conditions and different scarification methods was not significantly different. Earthen pot and mechanical treatment had higher percentage germination for seeds of *A. lebbeck, L. leucocephala,* and *T. bracteolata* while higher germination was observed in earthen pot and the unstored control for *E. cyclocarpum* (Table 2).

Table 2: Interaction Effects of Storage Condition and Scarification Method on Percentage Germination of Pasture Legume Seeds

STORAGE	SCARIFICA-TION	EC	AS	AL	LL	TB
Deep freezer	ACID	62.96^{bc}	71.48^{bcd}	33.70^{cdef}	29.26 ^{cd}	54.44 ^{ab}
	HW at 60^{o}C	58.89 ^{cd}	67.78^{cde}	39.26^{cd}	38.15 ^{b}	40.74 ^{abcd}
	HW at 100^{o}C	51.85 ^{cde}	64.82^{cdef}	40.74 ^{cd}	40.37 ^{b}	42.22 ^{abcd}
	MECHANICAL	54.82 ^{cde}	67.78^{cde}	49.26 ^{bc}	34.07 ^{bc}	49.63 ^{abc}
	CONTROL	56.30 ^{cde}	62.96^{cdef}	45.56 ^{cd}	22.59 ^{bcdef}	32.59 ^{cdefg}
Refrigerator	ACID	40.74 ^{cdegf}	44.44^{fghi}	34.44 ^{cde}	12.22 ^{def}	21.85 ^{efgh}
	HW at 60^{o}C	44.82 ^{cdefg}	47.04^{efgh}	41.48 ^{cd}	24.44 ^{bcde}	19.26 ^{fgh}
	HW at 100^{o}C	44.07 ^{cdefg}	45.56^{fghi}	31.11 ^{cdef}	14.44 ^{cdef}	17.78 ^{fgh}
	MECHANICAL	45.19 ^{cdefg}	52.59^{cdef}	35.93 ^{cd}	16.30 ^{cdef}	21.11 ^{fgh}
	CONTROL	38.89 ^{defg}	43.70^{fghi}	30.00 ^{cdefg}	11.48 ^{def}	18.52 ^{fgh}
Wooden box	ACID	34.44^{fgh}	38.52^{ghij}	34.07 ^{cde}	22.22 ^{bcdef}	19.63 ^{fgh}
	HW at 60^{o}C	46.67 ^{cdefg}	37.04^{ghij}	33.33 ^{cdef}	22.96 ^{bcdef}	11.48 ^{h}
	HW at 100^{o}C	37.78^{efg}	27.41^{hij}	30.00 ^{cdefg}	22.96 ^{bcdef}	12.96 ^{h}
	MECHANICAL	40.00^{defg}	35.19^{ghij}	25.93 ^{defgh}	23.33 ^{bcdef}	22.96 ^{efgh}
	CONTROL	29.26^{ghi}	34.44^{ghij}	29.26 ^{cdefg}	22.59 ^{bcdef}	13.70 ^{gh}
Earthen pot	ACID	80.37^{ab}	84.82^{abc}	68.15 ^{ab}	75.56 ^{a}	50.74 ^{abc}
	HW at 60^{o}C	91.85^{a}	93.70^{a}	70.74 ^{a}	78.52 ^{a}	47.41 ^{abcd}
	HW at 100^{o}C	80.00^{ab}	84.44^{abc}	75.56 ^{a}	84.00 ^{a}	57.04 ^{a}
	MECHANICAL	89.85^{ab}	91.48^{ab}	82.59 ^{a}	79.26 ^{a}	36.29 ^{bcdef}
	CONTROL	80.37^{a}	83.70^{abc}	74.82 ^{a}	85.93 ^{a}	45.56 ^{abcd}
Unstored	ACID	15.56^{hi}	25.93^{hij}	8.15 ^{h}	2.96 ^{f}	28.52 ^{defgh}
	HW at 60^{o}C	17.04^{hi}	23.70^{ij}	13.70 ^{fgh}	8.15 ^{ef}	18.89 ^{fgh}
	HW at 100^{o}C	11.48^{i}	27.78^{hij}	10.37 ^{gh}	3.70 ^{f}	10.00 ^{h}
	MECHANICAL	17.48^{i}	24.82^{ij}	8.89 ^{h}	6.6ef	13.70 ^{gh}
	CONTROL	16.29^{hi}	21.48^{j}	14.44 ^{efgh}	4.07 ^{ef}	15.19 ^{gh}
P =		0.00	0.13	0.00	0.00	0.03

$^{a-j}$ means in each column with the same letter are significantly different (P<0.05)
EC- *Enterolobium cyclocarpum,* AS- *Albizia saman, AL- Albizia lebbeck,* LL- *Leucaena leucocephala,* TB- *Tephrosia bracteolata*

E. cyclocarpum seeds had highest value (61.47%) after six months of storage in September and the least value (35.81%) was recorded at the second month of storage in May. The highest (67.73%) percentage germination of *A. saman* was after seven months of storage in October and least value (31.47%) was by the second month of storage in May and this also applies to *A. lebbeck* seeds which had the highest value (53.20%) after six months of storage in September and the least value (29.47%) at the second month of storage in May and *L. leucocephala* seeds. *T. bracteolata* seeds had highest value (42.27%) after two months of storage in May and the least (16.00%) at five months of storage in August (Table 3).

The effects of interaction on storage conditions and scarification methods were significantly ($P<0.05$) different across the forage seeds under study. The highest germination of *E. cyclocarpum* was when mechanically scarified while the least germination percentage were observed when *E. cyclocarpum* seeds were left unstored irrespective of the scarification methods. Similar trend was noted for all other seeds under study (Table 3).

The interaction effects on scarification and length of storage in months were significantly ($P<0.05$) different across the forage seeds under study. The highest percentage germination of *E. cyclocarpum* was in hot water treatment at 100^{o}C and stored for six months. Similar trend was observed for the five legume seeds except for *T. bracteolata* which had the highest value (78.00%) when treated with acid after nine months of storage and least value was recorded when treated with hot water at 100^{o}C after 5 months of storage (Table 3). The seeds treated with hot water at 100^{0}C for few seconds after being stored for six months (September) had best result (98.67%) compared to seeds that were not scarified (0.00%) for *E. cyclocarpum* and this applied to all the seeds except for *T. bracteolata* which had highest value (78.00%) when scarified with acid after nine months of storage in December and least value (4.67%) when subjected to hot water treatment after five months of storage in August (Table 3).

Seeds of *E. cyclocarpum* stored in wooden box with silica gel for nine (9) months (December) had the best result of (72.00%) compared to seeds stored in deep freezer for eight months (November) which had the least value of 22.00% germination. Seeds of *A. saman* stored under earthen pot for six months (September) had the highest value of 77.33% germination while seeds stored in deep freezer for nine months (December) had the least value of 22.00% germination. Seeds of *A. lebbeck* stored in wooden box with silica gel for nine months (December) had the best result (62.67%) compared to seeds stored under deep freezer and in November which had the least value of (20.00%). Seeds of *L. leucocephala* stored under deep freezer and July had the highest value of (60.00%) compared to seeds stored under deep freezer and in November which had (6.67%) the least value. Seeds of *T. bracteolata* stored under refrigerator in October had the highest value of (56.00%) compared to seeds stored under earthen pot and at June which had (7.33%) as lowest value (Table 4).

Table 3: interaction effects of scarification method and length of storage on percentage germination of pasture legume seeds

Scarification	Months	EC	AS	AL	LL	TB
ACID	1	58.00 ghijklmn	73.33 cdef	64.00 abcd	61.33 de	47.33 b-g
	2	37.33 l-u	37.33 j-o	24.67 h-m	19.33 g-o	23.33 e-p
	3	35.33 m-u	18.67 no	16.67 i-m	15.33 g-o	22.00 h-p
	4	84.00 abcdef	77.33 abcdef	76.00 abc	68.00 bcde	36.00 d-k
	5	22.67 cqrstuv	24.00 lmno	18.00 h-m	10.00 i-o	17.33 i-p
	6	32.67 o-u	37.33 j-o	19.33 h-m	12.00 h-o	49.33 b-f
	7	38.00 l-t	17.33 no	28.00 h-m	5.33 l-o	29.33 d-n
	8	40.67 k-s	14.00 o	27.33 h-m	10.00 i-o	18.67 i-p
	9	50.67 g-o	74.67 abcdef	64.00 abcd	34.00 fgh	78.00 a
HW at 60°C	1	17.33 stuv	14.00 o	8.67 lm	2.00 no	36.00 d-k
	2	38.67 l-t	52.67 g-k	36.67 e-j	22.00 g-o	62.00 abc
	3	35.33 m-u	34.67 j-o	28.67 f-l	23.33 g-o	24.27 f-p
	4	48.00 h-o	34.00 k-o	29.33 f-l	30.67 g-j	18.67 i-p
	5	74.00 bcdefg	81.33 abcde	68.00 abc	92.00 a	38.67 e–j
	6	16.00 tuv	22.67 lmno	10.67 klm	16.00 g-o	32.00 d-l
	7	50.67 g-o	69.33 defghi	42.00 j-n	16.67 g-o	60.67 abc
	8	44.00 i-q	45.33 ijkl	36.67 e-j	1.33 no	26.00 e-p
	9	60.00 fghijkl	42.00 j-n	34.67 e-k	6.00 l-o	20.67 i-p
HW at 100°C	1	86.00 abcd	88.67 abcd	76.00 abc	98.00 a	41.33 c-h
	2	20.67 qrstuv	26.00 lmno	9.33 lm	4.00 mno	28.00 d-o
	3	62.67 efghij	59.33 e-j	30.00 f-l	27.33 g-l	25.33 e-p
	4	34.67 n-u	25.33 lmno	13.33 j-m	8.00 k-o	4.67 op
	5	19.33 rstuv	20.67 mno	11.33 klm	11.33 i-o	4.00 p
	6	98.67 a	100.00 a	84.67 a	88.6 ab	35.33 d-k
	7	13.33 tuv	12.67 o	9.33 lm	2.67 no	10.67 l-p
	8	72.67 bcdefg	76.00 abcdef	54.67 bcde	36.00 fg	24.0 f-p
	9	59.33 g-m	72.00 e-h	70.67 abc	16.00 g-o	17.33 i-p
MECHANI-CAL	1	50.67 g-o	46.00 hijkl	52.00 e-g	54.67 ef	10.67 l-p
	2	94.00 ab	94.67 abc	72.67 abc	88.00 ab	28.67 d-o
	3	30.67 o-u	39.33 j-n	16.00 i-m	9.33 j-o	12.00 k-p
	4	68.67 cdefgh	79.33 abcde	65.33 abcd	32.00 ghi	48.00 b-f
	5	47.33 h-o	70.00 e-i	54.67 bcde	13.33 h-o	19.33 i-p
	6	36.67 m-u	68.00 d-i	52.67 cdef	37.33 fg	20.67 g-p
	7	88.00 abc	89.33 abcd	76.00 abc	84.00 abc	52.00 bc
	8	4.67 v	32.00 k-o	15.33 i-m	2.00 no	6.00 n-p
	9	61.33 e-k	74.00 cdef	25.33 h-m	26.67 g-l	33.33 d-l
CONTROL	1	42.67 l-r	47.33 g-l	22.00 h-m	26.00 g-m	19.33 i-p
	2	30.67 o-u	34.67 j-o	25.33 h-m	28.67 g-l	14.00 k-p
	3	85.33 abcd	83.33 abcde	77.33 a	93.33 a	48.00 bcdef
	4	4.00 v	22.67 l-o	8.67 lm	0.00 o	8.67 m-p
	5	67.33 cdefghi	81.33 abcde	38.00 e-i	62.00 cde	45.33 b-h
	6	46.00 h-p	70.67 cdefg	32.67 f-l	29.3g-k	13.33 k-p
	7	17.33 stuv	32.67 klmno	25.33 h-m	11.33 l-o	16.00 j—p
	8	98.67 a	99.33 ab	74.67 abc	80.00 abcd	68.67 ab
	9	0.00 v	29.3 k-o	4.00 m	0.00 o	4.67 n-p
P =	0.00	0.00	0.00	0.00	0.00	0.00

EC- *Enterolobium cyclocarpum,* AS- *Albizia saman, AL- Albizia lebbeck,* LL- *Leucaena leucocephala,* TB- *Tephrosia bracteolata*

Table 4: Interaction Effects of Storage Conditions and Length of Storage on Percentage Germination of Pasture Legume Seeds

Storage Condition	Months	EC	AS	AL	LL	TB
DEEP FREEZER	1	36.67 ab	34.00 h-l	44.67 ab	25.33 bcde	34.67 abcde
	2	55.33 ab	56.00 a-j	36.67 ab	34.67 abcde	25.33 abcde
	3	47.33 ab	40.67 f-l	32.67 ab	30.00 acde	29.33 abcde
	4	53.33 ab	58.67 a-i	44.67 ab	60.00 a	30.00 abcde
	5	44.67 ab	41.33 e-l	40.67 ab	24.00 bcde	26.67 abcde
	6	35.33 ab	30.67 jkl	32.00 ab	12.00 de	53.33 ab
	7	43.33 ab	30.67 jkl	26.00 ab	12.00 de	41.33 abcd
	8	22.00 ab	22.00 l	20.00 ab	6.67 e	34.00 abcde
	9	35.33 ab	37.33 g-l	32.00 ab	12.67 de	48.00 abc
REFRIGERATOR	1	43.33 ab	38.67g-l	37.33 ab	20.00 bcde	34.67 abcde
	2	44.67 ab	44.17 e-l	33.33 ab	36.67 abcde	48.67 abc
	3	46.67 ab	40.00 f-l	40.67 ab	39.33 abcd	32.67 abcde
	4	33.33 ab	35.33 h-l	32.67 ab	39.33 abcd	32.67 abcde
	5	44.00 ab	60.67 a-h	26.67 ab	32.00 abcde	26.00 abcde
	6	43.33 ab	50.67 b-l	40.00 ab	41.33 abcd	36.00 abcde
	7	40.00 ab	49.33 c-l	29.33 ab	24.00bcde	56.00 a
	8	43.67 ab	46.00 d-l	31.33 ab	20.00 bcde	32.67 abcde
	9	53.33 ab	60.00a-i	46.00 ab	37.33 abcd	28.67 abcde
WOODEN BOX	1	58.00 ab	57.33 a-i	40.00 ab	22.67 bcde	32.00 abcde
	2	55.33 ab	58.67 a-i	52.00 ab	22.00 bcde	27.33 abcde
	3	48.67 ab	55.33 a-j	32.00 ab	24.67 bcde	28.00 abcde
	4	48.00 ab	46.00 e-l	30.00 ab	36.67 abcde	12.00 de
	5	48.67 ab	40.67 f-l	26.00 ab	33.33 abcde	14.67 de
	6	43.33 ab	37.33 g-l	31.33 ab	18.67 cde	14.67 de
	7	40.00 ab	38.67 g-l	29.33 ab	24.67 bcde	10.67 de
	8	68.00 a	75.33 abc	46.67 ab	46.00 abc	34.00 abcde
	9	72.00 a	76.00 abc	62.67 a	50.00 ab	14.00 de
EARTHEN POT	1	56.00 ab	62.67 a-g	56.00 ab	45.33 abc	26.67 abcde
	2	59.33 ab	56.00 a-j	5.00 ab	31.33 abcde	10.67 de
	3	52.00 ab	58.00 a-i	42.67 ab	31.33 abcde	7.33 e
	4	52.00 ab	69.33 abcde	42.67 ab	27.33 bcde	11.33 de
	5	57.33 ab	66.00 a-f	62.67 a	37.33abcd	41.33 abcd
	6	49.33 ab	77.33 a	54.00 ab	36.67 abcd	35.33 abcde
	7	45.33 ab	69.33 abcd	58.67 ab	35.33 abcde	38.00 abcde
	8	41.33 ab	56.67 a-j	46.00 ab	32.00 abcde	20.00 cde
	9	46.00 ab	63.33 a-g	31.33 ab	36.00 abcde	21.33 bcde
CONTROL	1	45.33 ab	63.33 a-g	35.33 ab	38.67 abcd	22.00 bcde
	2	54.00 ab	59.33 a-i	30.00 ab	35.33 abcde	26.67 abcde
	3	46.67 ab	45.33 e-l	36.00 ab	31.33 abcde	28.67 abcde
	4	32.00 ab	30.67 1-l	26.00 ab	33.33 abcde	24.67 abcde
	5	50.00 ab	61.33 a-h	29.33 ab	28.67 bc	28.00 abcde
	6	44.00 ab	62.67 a-g	32.00 ab	41.33 abcd	26.67 abcde
	7	41.33 ab	52.00 a-l	40.67 ab	34.00 abcde	26.67 abcde
	8	48.00 ab	67.33 abcde	37.33 ab	43.33 abc	30.67 abcde
	9	46.00 ab	70.00 abcd	35.33 ab	35.33 abcde	38.67 abcd
P =		0.00	0.00	0.00	0.00	0.00

a-l means in a column with the same letter are not significantly different (P<0.05)

EC- *Enterolobium cyclocarpum,* AS- *Albizia saman, AL- Albizia lebbeck,* LL- *Leucaena leucocephala,* TB- *Tephrosia bracteolata*

Generally, the highest percentage germination was when the seeds were stored in earthen pots, treated with hot water at 100^{0}C and six months of storage (66.66%), followed by use of earthen pots for storage for six months with hot water treatment at 60^{0}C (65.94%), then storage in earthen pot for six months with scarification with sandpaper (64.70%), then storage in earthen pots for six months and acid treatment (64.26%) for the seeds of *E. cyclocarpum* with higher values for *A. saman* and lower values for *A. lebbeck, L. leucocephala*, and *T. bracteolata* with similar trend but some have the highest values in seven months of storage (Table 5). The highest percentage germination ranges between 30% and 70% while the least between 13% and 49% for control treatments with seeds that were not stored and no treatment as presented on table 5.

Table 5: Interaction Effects of Storage Condition, Scarification Method and Length of Storage on Percentage Germination of Pasture Legume Seeds

Storage Condition	Scarification Method	Length Of Storage (Months)	EC	AS	AL	LL	TB
Deep freezer	ACID	1	50.39cd	55.38cd	39.09bc	32.04bc	36.05ab
		2	46.53cd	50.49cd	35.62bcd	24.67cd	40.41a
		3	48.70cd	55.02cd	37.36bc	32.71bc	38.05ab
		4	51.99cd	58.09cd	39.04bc	28.84cd	38.10ab
		5	49.81cd	54.53cd	35.71bc	29.64cd	31.65ab
		6	55.06cd	61.67bc	43.53abc	34.04bc	32.50ab
		7	50.93cd	62.58bc	43.40abc	31.69bc	36.05ab
		8	49.50cd	57.47cd	36.38bc	32.09bc	34.54ab
		9	49.86cd	60.89bc	37.44bc	32.62bc	36.19ab
	HW at 60^{o}C	1	52.10cd	55.65cd	40.42bc	34.04bc	33.56ab
		2	48.21cd	50.76de	36.96bc	26.67cd	37.92ab
		3	50.38cd	55.29cd	38.69bc	34.71bc	35.56ab
		4	53.67cd	58.36cd	40.38bc	30.84bc	35.60ab
		5	51.49cd	54.80cd	37.04bc	31.64bc	29.16abc
		6	56.74cd	61.94bc	44.87abc	36.04bc	30.00abc
		7	52.61cd	62.85bc	44.73abc	33.69bc	33.56ab
		8	51.18cd	57.74cd	37.71bc	34.09bc	32.05ab
		9	51.54cd	61.16bc	38.78bc	34.62bc	33.69ab
	HW at 100^{o}C	1	49.80cd	54.36cd	39.71bc	33.60bcd	33.71ab
		2	45.93cde	49.48de	36.24bc	26.22cd	38.06ab
		3	48.11cd	54.01cd	37.98bc	34.27bc	35.71ab
		4	51.40cd	57.08cd	39.66bc	30.40bcd	35.75ab
		5	49.22cd	53.52cd	36.33bc	31.20bc	29.31abc
		6	54.47cd	60.65bc	44.15abc	35.60bc	30.15abc
		7	50.33cd	61.56bc	44.02abc	33.24bc	33.71ab
		8	48.91cd	56.45cd	37.00bc	33.64bc	32.20ab
		9	49.27cd	59.88bcd	38.06bc	34.18bc	33.84ab

	SANDPAPER	1	50.84cd	55.82cd	40.69bc	33.21bc	33.95ab
		2	46.97cd	50.93de	37.23bc	25.83cd	38.31ab
		3	49.15cd	55.47cd	38.96bc	33.87bc	35.95ab
		4	52.44cd	58.53cd	40.65bc	30.01bc	36.00ab
		5	50.26cd	54.98cd	37.31bc	30.81bc	29.55abc
		6	55.50bcd	62.11bc	45.14abc	35.21bc	30.40ab
		7	51.37cd	63.02bc	45.00abc	32.85bc	33.95ab
		8	49.95cd	57.91cd	37.98bc	33.25bc	32.44ab
		9	50.30cd	61.33bc	39.05bc	33.78bc	34.09ab
	CONTROL	1	49.53cd	54.12cd	40.13bc	32.34bc	32.74ab
		2	45.66cd	49.23de	36.66bc	24.96bcd	37.10ab
		3	47.84cd	53.76cd	38.40bc	33.01bc	34.74ab
		4	51.13cd	56.83cd	40.08bc	29.14cd	34.79ab
		5	48.95cd	53.27cd	36.75bc	29.94cd	28.34bc
		6	54.20bcd	60.41bcd	44.57abc	34.34bc	29.19bc
		7	50.06cd	61.32bc	44.44abc	31.98cd	32.74abc
		8	48.64cd	56.21cd	37.42bc	32.38cd	31.23bc
		9	49.00cd	59.63cd	38.48bc	32.92cd	32.88abc
Refrigerator	ACID	1	45.67cd	48.61de	36.72bc	26.34cde	27.98bc
		2	41.81de	43.73de	33.25bcd	18.96efg	32.34abc
		3	43.98cd	48.26de	34.99bcd	27.01cd	29.98bc
		4	47.27cd	51.33de	36.67bc	23.14cd	30.02bc
		5	45.09cd	47.77de	33.34bcd	23.94cd	23.58bcd
		6	50.34cd	54.90cd	41.16bc	28.34cd	24.42bcd
		7	46.21cd	55.81cd	41.03bc	25.98cd	27.98bc
		8	44.78cd	50.70de	34.01bcd	26.38cd	26.47bcd
		9	45.14cd	54.13cd	35.07bc	26.92cd	28.11bc
	HW at 60°C	1	47.35cd	48.88de	38.05bc	28.34cd	25.49bcd
		2	43.49cd	44.00de	34.59bcd	20.96cdef	29.84bc
		3	45.66cd	48.53de	36.32bc	29.01cd	27.49bc
		4	48.95cd	51.60de	38.01bc	25.14cd	27.53bc
		5	46.77cd	48.04de	34.67bcd	25.94cd	21.09bcd
		6	52.02cd	55.17cd	42.50bc	30.34cd	21.93bcd
		7	47.89cd	56.08cd	42.36bc	27.98cd	25.49bc
		8	46.46cd	50.97de	35.34bcd	28.38cd	23.98bcd
		9	46.82cd	54.40cd	36.41bc	28.92cd	25.62bc

	HW at 100°C	1	45.08cd	47.60ef	37.34bc	27.90cd	25.63bc
		2	41.21cde	42.71ef	33.87bcd	20.52cde	29.99bc
		3	43.39cd	47.25ef	35.61bcd	28.56cd	27.63bc
		4	46.68cd	50.31de	37.29bc	24.70cde	27.68bc
		5	44.50cd	46.76ef	33.96bcd	25.50cd	21.23bcd
		6	49.75bc	53.89cd	41.78bc	29.90cd	22.08bcd
		7	45.61cd	54.80cd	41.65bc	27.54cd	25.63bc
		8	44.19cd	49.69de	34.63bcd	27.94cd	24.12bc
		9	44.55cd	53.11cd	35.69bcd	28.47cd	25.77bc
	SANDPAPER	1	46.12cd	49.06de	38.32bc	27.50cd	25.88bc
		2	42.25cd	44.17ef	34.86bcd	20.13cdef	30.24bc
		3	44.43cd	48.70ef	36.59bc	28.17cd	27.88bc
		4	47.72cd	51.77de	38.28bc	24.30cde	27.92bc
		5	45.54cd	48.21ef	34.94bcd	25.10cd	21.48bcd
		6	50.78cd	55.35cd	42.77bc	29.50cd	22.32bcd
		7	46.65cd	56.26cd	42.63bc	27.15cd	25.88bc
		8	45.23cd	51.15de	35.61bc	27.55cd	24.37bc
		9	45.58cd	54.57cd	36.68bc	28.08cd	26.01bc
	Control	1	44.81cd	47.35ef	37.76bc	26.64cd	24.67bc
		2	40.94cde	42.47ef	34.29bcd	19.26efg	29.03abc
		3	43.12cd	47.00ef	36.03bc	27.30cd	26.67bc
		4	46.41cd	50.07de	37.71bcd	23.44cde	26.71bc
		5	44.23cd	46.51ef	34.38bcd	24.24cde	20.27bcd
		6	49.48bc	53.64cd	42.20bc	28.64cd	21.11bcd
		7	45.34cd	54.55cd	42.07bc	26.28cd	24.67bc
		8	43.92cd	49.44de	35.05bc	26.68cd	23.16bc
		9	44.28cd	52.87cd	36.11bc	27.21cd	24.80bc
Wooden box	ACID	1	43.97cd	44.56	35.36bc	28.68cd	26.80bc
		2	40.10cde	39.68ef	31.90bcd	21.31cde	31.15abc
		3	42.28cd	44.21ef	33.63bcd	29.35cd	28.80bc
		4	45.57cd	47.28ef	35.32bc	25.48cde	28.84bc
		5	43.39cd	43.72ef	31.98bcd	26.28cde	22.40bcd
		6	48.64bc	50.85de	39.81bc	30.68cd	23.24bcd
		7	44.50cd	51.76cd	39.67bc	28.33cd	26.80bc
		8	43.08cd	46.65def	32.65bcd	28.73cd	25.29bc
		9	43.44cd	50.08de	33.72bcd	29.26cd	26.93bc
	HW at 60°C	1	45.65cd	44.83de	36.70bc	30.68cd	24.30bcd
		2	41.78de	39.95efg	33.23bcd	23.31de	28.66bc
		3	43.96cd	44.48de	34.96bc	31.35cd	26.30bc
		4	47.25cd	47.55de	36.65bc	27.48cd	26.35bc
		5	45.07cd	43.99def	33.32bcd	28.28cd	19.90def
		6	50.32bc	51.12cd	41.14bc	32.68cd	20.75de
		7	46.18bcd	52.03cd	41.01bc	30.33cd	24.30bcd
		8	44.76cd	46.92de	33.98bcd	30.73cd	22.79cd
		9	45.12cd	50.35cd	35.05bc	31.26cd	24.44bcd
	HW @ 100	1	43.38cd	43.55def	35.98bc	30.24cd	24.45bcd
		2	39.51def	38.66efg	32.52bcd	22.86de	28.81bc
		3	41.69de	43.20def	34.25bc	30.91cd	26.45bcd
		4	44.98cd	46.26de	35.94bc	27.04cd	26.49bcd
		5	42.80cd	42.71de	32.60bcd	27.84cd	20.05cd

		6	48.04bcd	49.84cd	40.43bc	32.24cd	20.89cd
		7	43.91cd	50.75cd	40.29bc	29.88cd	24.45bcd
		8	42.49cd	45.64de	33.27bc	30.28cd	22.94bcd
		9	42.84cd	49.06cd	34.34bc	30.82cd	24.58bcd
	SANDPAPER	1	44.41cd	45.01de	36.97bc	29.85cd	24.70bcd
		2	40.55de	40.12def	33.50bc	22.47de	29.05bc
		3	42.72cd	44.65de	35.23bc	30.51cd	26.70bcd
		4	46.01cd	47.72cd	36.92bc	26.65cd	26.74bcd
		5	43.83cd	44.16de	33.59bc	27.45cd	20.30bcd
		6	49.08cd	51.30cd	41.41bc	31.85cd	21.14bcd
		7	44.95cd	52.21cd	41.28bc	29.49cd	24.70bcd
		8	43.52cd	47.10cd	34.25bc	29.89cd	23.19bcd
		9	43.88cd	50.52cd	35.32bc	30.42cd	24.83bcd
	CONTROL	1	43.11cd	43.30de	36.40bc	28.98cd	23.49bcd
		2	39.24def	38.42ef	32.94bc	21.60de	27.84bc
		3	41.42de	42.95de	34.67bc	29.65cd	25.49bcd
		4	44.71cd	46.02de	36.36bc	25.78de	25.53bcd
		5	42.53d	42.46de	33.02bc	26.58de	19.09def
		6	47.77cd	49.59cd	40.85bc	30.98cd	19.93def
		7	43.64cd	50.50cd	40.71bc	28.62de	23.49bcd
		8	42.22d	45.39de	33.69bc	29.02cde	21.98bcd
		9	42.57d	48.82cd	34.76bc	29.56cde	23.62bcd
EARTHEN POT	ACID	1	59.59ab	62.27bc	49.98ab	47.96a	37.21ab
		2	55.72c	57.38cd	46.51ab	40.59bc	41.57ab
		3	57.90bc	61.91bc	48.25ab	48.63a	39.21ab
		4	61.19ab	64.98ab	49.93ab	44.76ab	39.26ab
		5	59.01ab	61.42bc	46.60ab	45.56ab	32.81bc
		6	64.26a	68.56a	54.42a	49.96a	33.66bc
		7	60.12ab	69.47a	54.29a	47.61ab	37.21ab
		8	58.70b	64.36ab	47.27ab	48.01ab	35.70ab
		9	59.06b	67.78a	48.33ab	48.54ab	37.35ab
	HW@60	1	61.27a	62.54ab	51.31ab	49.96a	34.72ab
		2	57.40bc	57.65bc	47.85ab	42.59bc	39.08a
		3	59.58b	62.18ab	49.58ab	50.63a	36.72ab
		4	62.87a	65.25ab	51.27ab	46.76ab	36.76ab
		5	60.69ab	61.69abc	47.93ab	47.56ab	30.32bc
		6	65.94a	68.83a	55.76a	51.96a	31.16bc
		7	61.80a	69.74a	55.62a	49.61a	34.72abc
		8	60.38ab	64.63ab	48.60ab	50.01a	33.21abc
		9	60.74ab	68.05a	49.67ab	50.54a	34.85abc
	HW@100	1	59.00b	61.25bc	50.60ab	49.52a	34.87abc
		2	55.13c	56.37cd	47.13ab	42.14bc	39.22ab
		3	57.31bc	60.90bc	48.87ab	50.19a	36.87ab
		4	60.60ab	63.97bc	50.55ab	46.32bc	36.91ab
		5	58.42b	60.41bc	47.22ab	47.12bc	30.47bc
		6	63.66a	67.54ab	55.04a	51.52a	31.31bc
		7	59.53b	68.45a	54.91a	49.16a	34.87abc
		8	58.11b	63.34bc	47.89ab	49.56a	33.36abc
		9	58.4b6	66.77ab	48.95ab	50.10a	35.00abc
	SANDPAPER	1	60.0ab3	62.71ab	51.58ab	49.13a	35.11abc
		2	56.17bc	57.82bc	48.12ab	41.75bc	39.47ab
		3	58.34b	62.36ab	49.85ab	49.79a	37.11ab
		4	61.63a	65.42ab	51.54ab	45.93bc	37.16ab
		5	59.45ab	61.87ab	48.20ab	46.73bc	30.71bc
		6	64.70a	69.00ab	56.03a	51.13a	31.56bc
		7	60.57ab	69.91ab	55.89a	48.77ab	35.11abc
		8	59.14b	64.80ab	48.87ab	49.17a	33.60bc
		9	59.50ab	68.22ab	49.94ab	49.70a	35.25abc

	CONTROL	1	58.73bc	61.01ab	51.02ab	22.78de	33.90bc
		2	54.86bc	56.12bc	47.55ab	15.40efg	38.26ab
		3	57.04bc	60.65bc	49.29ab	23.45de	35.90abc
		4	60.33ab	63.72bc	50.97ab	19.58efg	35.95abc
		5	58.15bc	60.16bc	47.64ab	20.38ef	29.50bc
		6	63.39ab	67.30ab	55.46a	24.78de	30.35bc
		7	59.26ab	68.21ab	55.33a	22.42de	33.90bc
		8	57.84bc	63.10bc	48.31ab	22.82de	32.39bc
		9	58.19bc	66.52ab	49.37ab	23.36de	34.04bc
UNSTORED CONTROL	ACID	1	36.62def	41.30de	28.89bc	22.78de	27.17bc
		2	32.75ef	36.42ef	25.43bcd	15.40efg	31.52bc
		3	34.93ef	40.95ef	27.16bc	23.45de	29.17bc
		4	38.22def	44.02de	28.85bc	19.58efg	29.21bc
		5	36.04ef	40.46ef	25.51bcd	20.38ef	22.77bcd
		6	41.28def	47.59cd	33.34bc	24.78de	23.61bcd
		7	37.15def	48.50cd	33.20bc	22.42def	27.17bc
		8	35.73ef	43.39cd	26.18bc	22.82def	25.66bc
		9	36.08ef	46.82cd	27.25bc	23.36de	27.30bc
	HW@60	1	38.30def	41.57de	30.23bc	24.78de	24.67bcd
		2	34.43ef	36.69ef	26.76bcd	17.40efg	29.03bc
		3	36.61def	41.22de	28.49bc	25.45de	26.67bc
		4	39.90de	44.29cd	30.18bc	21.58def	26.72bc
		5	37.72def	40.73de	26.85bc	22.38def	20.27bcd
		6	42.96cde	47.86bcd	34.67bc	26.78de	21.12bcd
		7	38.83def	48.77bcd	34.54bc	24.42de	24.67bc
		8	37.41def	43.66cd	27.51cd	24.82de	23.16bc
		9	37.76def	47.09bcd	28.58cd	25.36de	24.81bc
	HW@100	1	36.02def	40.29de	29.51cd	24.34de	24.82bc
		2	32.16ef	35.40de	26.05cd	16.96efg	29.18bc
		3	34.33ef	39.94de	27.78cd	25.00de	26.82bc
		4	37.62def	43.00cd	29.47cd	21.14def	26.86bc
		5	35.44def	39.45de	26.13cd	21.94def	20.42bcd
		6	40.69def	46.58cd	33.96bc	26.34de	21.26bcd
		7	36.56def	47.49cd	33.82bc	23.98de	24.82bc
		8	35.13ef	42.38cd	26.80cd	24.38de	23.31bc
		9	35.49ef	45.80cd	27.87cd	24.91de	24.95bc
	SANDPA-PER	1	37.06def	41.75cd	30.50bc	23.94de	25.07bc
		2	33.19ef	36.86de	27.03cd	16.57efg	29.42bc
		3	35.37ef	41.39cd	28.76cd	24.61de	27.07bc
		4	38.66def	44.46cd	30.45bc	20.74de	27.11bc
		5	36.48def	40.90de	27.12cd	21.54de	20.67bcd
		6	41.73def	48.04bc	34.94bc	25.94de	21.51bcd
		7	37.59def	48.95bc	34.81bc	23.59de	25.07bc
		8	36.17def	43.84cd	27.78cd	23.99de	23.56bc
		9	36.5def3	47.26bc	28.85cd	24.52de	25.20bc
	CONTROL	1	35.75def	40.04cd	29.93cd	23.08de	23.86bc
		2	31.89ef	35.16cde	26.47cd	15.70efg	28.21bc
		3	34.06ef	39.69cde	28.20cd	23.74de	25.86bc
		4	37.35def	42.76cd	29.89cd	19.88efg	25.90bc
		5	35.17def	39.20cde	26.55cd	20.68efg	19.46def
		6	40.42def	46.33bc	34.38bc	25.08de	20.30bcd
		7	36.29def	47.24bc	34.24bc	22.72def	23.86bc
		8	34.86ef	42.13bc	27.22cd	23.12def	22.35bcd
		9	35.22def	45.56bc	28.29cd	23.65def	23.99bc

DISCUSSION

From the result of this study, the seeds stored in earth pots had the highest germination percentage in all the pasture legumes stored. The earthen pot fulfill the condition of cool and dry environment while avoiding high humidity that is prevalent inside deep freezer. But wooden box without silica gel to absorb moisture will not be too far from the unstored that are kept inside sacks. These results confirm the findings of (Roberts, 1973; Khan *et al.,* 1976), who reported that the lower the temperature, the lower the moisture content, the greater the longevity except recalcitrant seeds. The major cause of reduction in rate of germination under storage media is the moisture in the storage environment. Hence, the suggestions of use of powder in place of silica gel to absorb moisture for storing vegetable seeds. This is very pertinent because the most important factor determining seed storage life is storage temperature and moisture as reported by Harrington, 1973. The cool, dry condition was provided by the earthen pot.

Since application of hot water alone is not probably able to enhance germination to its maximum level and also not sufficient to induce a balance between dormancy inhibitors and promoters, therefore, applying of earthen pot storage and hot water at 60^{o}C for 10 minutes together can be more effective and the highest germination percentage can be obtained when stored under earthen pot and treated with hot water. From the results, it shows that the effects of length of storage on the seeds varies from one to nine months (April to December) when there variations in temperature and relative humidity as reported by Harrington, 1973.

Seeds treated with sandpaper (mechanical) maximally support growth and germination of all the seeds and this observation is consistent with that of Agboola (1995) and for small size seeds, the mechanical scarification can be improved by using abrasive drums especially when handling large quantity of seeds.

Treating seeds with concentrated sulphuric acid, increase germination rates from 50-66% and this can have important implications as reported by El-siddig *et al.* (2001) that concentrated sulphuric acid accelerated water uptake, who suggested the use for fast establishment of trees such as *A. saman* and *E. cyclocarpum* for multipurpose uses. Immersion of the seed in hot water for 10 minutes at 60^{o}C was the most rapid among the two hot water used, Aliero (2004) reported that immersion of seed in hot water for 4 minutes increased significantly the germination percentage. Hot water soaking gave higher percentage germination than the untreated.

The length of storage conditions (9 months) had significant effects ($P<0.05$) on percentage germination of the pasture legume seeds. Delouche *et al.* (1973) suggested that the reliable range of temperature and relative humidity for safe storage of good quality seed of the major tropical and sub-tropical crops have been determined for short term storage (1-9 months).

CONCLUSIONS

From the results of this study, it could be concluded that storing in earthen pot had the highest seed germination apart from the fact that it required no extra cost of electricity. This is highly innovative and further research can be on longer length of storage and the size or types of earthen pots.

Also, use of hot water at 60^0C for 10mins had the highest seed germination except for the seeds of T. bracteolate that have acid treatment with the highest germination. It could be concluded that scarification of pasture legume seeds with hot water and sand paper improved seed germinability by breaking dormancy which may be due to hard seed coat. In addition to been safer.

Results of this study may serve as useful information in the production and improvement of the tree species, as knowledge on seed germination requirements is a crucial factor in seedlings production.

Sandpaper should be used for local famers because it will save their cost and no risk attached to its uses and for large quantity of seeds it can be mechanized using scarifying drum.

Pasture legume seeds must be stored immediately and in appropriate storage medium after harvesting to prevent poor germination.

Storage of seeds under earthen pot had best among all the storage conditions and this can serve as opportunity for the local farmers who cannot afford refrigerator and in rural areas of the world with problems of electricity to power refrigerator of deep freezer or any other modern or sophisticated facilities.

Scarification of pasture legume seeds with hot water at 60^0C and sandpaper improved seed germinability by breaking the seed dormancy due to hard seed coats.

Combination of earthen pot and hot water treatments will produce excellent percentage and hence better seeds establishment.

Since *A. saman* consistently recorded a higher germination percentage, irrespective of the management technique (either treatments or storage) and therefore its use and establishment should be encouraged. In conclusion, the best condition for storage of pasture legume seeds is refrigerator but where there is no electricity or irregular power supply, they can be stored in earthen pot. Seeds of pasture legumes are better treated with sandpaper before planting to improve their germination ability.

RECOMMENDATION

Arising from the results of this experiment, the following recommendations are therefore made:

1. Further research work can be carried out on seedling emergence and seedling vigor.
2. Storage system using clay or earthen vessels are recommended from this study because it has the highest percentage germination of seeds especially when seeds are stored for nine months. The storage device do not need additional cost for electricity. There can be further studies on longer length of storage.
3. There should be control for the months before storage to know whether storage actually has effects on seeds or not.
4. There is need to mechanize scarification of large quantity of seeds with the use of scarifying drum.
5. Treatment of legume seeds such as *Enterolobium cyclocarpum* with hard seed coats should be done especially scarification with acid.

There is need for further studies of the effects of seed weights on seed germination.

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