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Influence of Storage on Soybean Germination Characteristic and Disease Occurrence

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ABSTRACT

Some soybean cultivars numbering twenty were grown at the University of Agriculture Makurdi Teaching and Research Farm in July 2006 and harvested October 5th and November 7th 2006 according to the time physiological maturity of the varieties. For each harvest population of the different culture, the moisture content and dry matter weight (oven method, 105°C for 72 h) were determined for samples of 10 seeds per replicate. The seed were stored under normal environment condition in cotton bags which were tied and kept for 7 months. Seed moisture contents were determined at different stage of storage. The germination test was performed and infected seeds were cultured using media of potatoes Dextrose Agar to identify the organisms according to the International Seed Testing Association in the Crop Science Laboratory of the University of Agriculture Makurdi, Nigeria, located at longitude 8.37°N. Within the Southern Guinea Savannah agro ecological zone of Nigeria. The results indicated that TGX 1838-5E and TGX 1440-1E showed higher viabilities by recording greater germination percentage. Doko, TGX 1896.3F and Milena soybean varieties recorded higher germination index while the lowest germination index occurred in TGX 1844-18E. The medium maturing type had the highest mean germination percentage (54.32%) followed by late maturing varieties. Presence of mycoflora found on soybean differs among fungi and soybean varieties. Higher percentage of *Aspergillus niger* was recorded in soybean variety TGX 1842-1E though *Aspergillus niger* was not found in soybean varieties TGX 1869-13E, TGX 1895-35F, TGX 1894-3F, TGX 1802-1F and TGX 1878-7F. Soybean variety TGX 1440-IE recorded higher percentage of *Aspergillus flavus*.

Keywords: Influence, Characteristics, Germination, Varieties, Soybean, Diseases, Occurrence

INTRODUCTION

Nigeria is the largest producer of Soybean (*Glycine max* (L.) Merril) in West Africa, and its major producing states are Kaduna, Niger, Kebbi, Nasarawa, Kwara, Oyo, Jigawa, Taraba, Borno, Benue, Bauchi, Lagos, Sokoto, Plateau, Zamfara and Abuja FCT [1].

It's among the species of legume and widely grown for its edible bean which has numerous uses. In Nigeria, it grows majorly in the middle belt accounting for 65-75% of the production in Nigeria.

Popularity of this crop is due to abundance high quality protein (43%) and cholesterol free rich source of oil (20%) and with high unsaturated fatty acids [2-4].

Seed quality is a multiple criterion that encompasses several important seed attributes: genetic and chemical composition, physical condition, physiological germination and vigour, size, appearance and presence of seed borne pathogens, crop and varietal purity.

Soybean is classified as "poor storer" as it loses viability drastically under warm and humid conditions due to frequent invasion by storage fungi [5-7]. Fungi are the major cause of spoilage in stored grains and seeds. It is reported in the literature that during storage several microbes including bacteria, nematodes, fungi contaminate seeds, had an adverse effect on seed quality [8]. The species of Aspergillus, Penicillium, Fusarium, Rhizopus and Alternaria have been found commonly occurring as post-harvest molds in storage condition [8]. Most of the species of Aspergillus are dominant and play vital role in the seed biodeterioration

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[9].

During storage, seed quality can remain at the initial level or decline to a level that may make the seed unacceptable for planting purpose what is related to many determinants: environments conditions during seed production, pests, diseases, seed oil content, seed moisture content, mechanical damages of seed in processing, storage longevity, package, pesticides, air temperature and relative air humidity in storage, biochemical injury of seed tissue and similarity [10-15].

MATERIALS AND METHODS

Twenty soybean varieties were grown at the University of Agriculture Makurdi Teaching and Research Farm in July 2006 and harvested October 5th and November 7th 2006 according to the time of physiological maturity of the varieties. From each harvested population of the different cultivar, the moisture content and dry matter weight (oven method, 105°C for 72 h) were determined for samples of 10 seeds per replicate. The seed were stored under normal environment condition in cotton bags which were tied and kept for 7 months. Seed moisture contents were determined at different stage of storage. The germination test was performed according to the International Seed Testing Association in the Crop Science Laboratory of the University of Agriculture Makurdi, Nigeria, located on longitude 8.37°N. Within the Southern Guinea Savannah agro ecological zone of Nigeria. Seeds of 20 soybean cultivars were evaluated using the following tests: seedling emergence on the Laboratory (G%), standard germination (first and final count), speed of emergence (GI), speed of emergence index (GRI). The seeds were examined physically with unaided eyes and were satisfied okay. 240 Petri-dished were immersed in water containing Omo (detergent) for some hours, to allow all foreign bodies to dissolve. The dishes were properly washed and later soaked in another water containing Jik (parazone or Sodium hypochloride solution for 24 h, to help in removing stubborn stains that may have eluded the Water containing the detergent and to further serve as a sterilizer. Disinfectant was prepared using 300 ml of distilled water and 700 ml of alcohol (ethanol). This measurement was carried out with a conical flask. This was poured into a measuring cylinder to give the 70% alcohol (disinfectant), then used in disinfecting the petri-dishes to avoid contamination of dishes or to kill foreign bodies' organism that may contaminate the seed before planting. The seeds were placed in well soaked filter paper placed inside the sterilized Petri-dishes using the blotter method. The varieties of soybean used are mentioned in **Table 1**.

Table 1. Varieties of soybean.

1	TGX 1805-31F (M)	11	TGX 1880-3F (M)
2	TGX 1844-18E (L)	12	TGX 194-3F (M)
3	TGX 1890 - 7F (M)	13	TGX 923-2E (L)
4	TGX 1838-5E (M)	14	TGX 1873-16E (M)
5	TGX 1844-4E (L)	15	TGX 1866-I6E (M)
6	TGX 1895-35F (L)	16	DOK0 (B)
7	TGX 1869 35F (L)	17	TGX 1802-1F (M)
8	TGX 1842-1E (M)	18	TGX 1878-7E (M)
9	TGX 1802-3F(M)	18	MILANA (B5)
10	TGX 1896-3F (L)	20	TGX 1802-3F (M)

Using Completely Randomized Design (CRD) with three replicates with a factor at 20 levels, there were 60 units replicated three times. Four Petri-dishes represent a unit. Each petri-dish has 25 seeds arranged on a filter paper. A total number of 100 seeds were used for a treatment in a replicate.

DATA COLLECTION

Daily observation was done on the seed and germination counts until there was no further germination occurred. Observation was also taken on the seeds to identify infected soybean seeds, type of infection, percentage and frequencies of infected seeds. The infected seeds were cultured using media of potatoes, Dextrose Agar to identify the organisms. In the laboratory, 10 seeds were used to determine moisture content using the direct method. A sample collected from each variety was weighted immediately and oven dried at 60°°C to a constant weight. The percentage moisture content was then calculated using the formula below:

$$\text{Loss in weight / Initial weight} \times 100$$

DATA COLLECTION AND ANALYSIS

The data generated from the experiment were used to compute the Germination percentage (G%) Germination Index (GI) and the Germination Rate Index (GRI).

Following the procedures of Fakorede and Ayoola [16] and Fakorede and Ojo [17]:

G% = Number of seeds germinated / Number of seeds planted × 100

GR = (No of seeds germinated on a day × Day after germination) / Total no. of seeds that germinated

GRI = GI / G % (expressed on 0-1 scale)

All data collected were subjected to analysis of variance, and means that showed significant difference were separated using the Duncan New Multiple Range Test (DNMRT) and F-L80 for data on germination.

RESULTS AND DISCUSSION

Soybean viability was determined and it was observed that TGX 1838-5E and TGX 1440-1E showed higher viabilities by recording greater and similar germination percentage. TGX 1844-18, TGX 1873-16E, TGX 1866-12F and TGX 1873-16E produced germination percentage of eighty percentages and above showing that storage condition has no negative effect on their viability. Germination capability of soybean varieties TGX 1895-35F, TGX 1890-7F, DOKO, TGX 1880-3E and TGX 9223-2E were affected by storage which means that these varieties would not withstand long storage condition **(Table 2)**.

Table 2. Mean germination characteristics of twenty varieties of soybean stored for seven months in Makurdi.

Varieties	G%	GI	GRI
TGX1805-31F	67.33	1.95	3.0
TGX 1844-18	87.33	1.59	2.0
TGX 1890-7F	17.67	1. 91	3.0
TGX 1838-5E	92.67	1.86	2.0
TGX 144-1E	92.67	1.86	2.0
TGX 1844-4E	75.00	1.87	3.0
TGX 1895-35F	0.00	0.00	0.0
TGX1869-13E	68.67	1.85	3.0
TGX 1842-1E	79.00	1.73	2.0
MILENA	53.67	2.19	4.0
TGX 1880-3E	37.33	1.97	50
TGX 1894-3F	80.33	1.93	2.0
TGX 9223-2E	39.33	1.90	5.0
TGX 1873-16E	84.67	1.98	2.0
TGX 1866-12F	83.33	1.88	2.0
DOKO	24.0	2 .17	9.0
TGX 1802-1F	76.33	1.93	3.0
TGX 1802	75.67	189	3.0
TGX 1802	58.67	1.78	3.0
TGX 1896.3F	75.0	2.10	3.0
CV	0.67	0.28	3.73
LSD	7.49	0.12	1.83

Germination index (GI) tells about the uniformity of the seed lot. It was indicated soybean germination index was significantly affected by storage condition in which soybean varieties exhibit different germination index. The Highest germination index was obtained at Doko, TGX 1896.3F and Milena and lowest germination index occurred at TGX 1844-18E. This showed that there was a highly significant difference between the varieties **(Table 2)**.

Germination rate index (GRI) showed the speed at which germination occurred. The result indicated that there was a highly significant difference between the variety in which the highest germination rate index was recorded in Doko, TGX 1880-3E and Milena and lowest germination rate index occurred at TGX 1844-18E **(Table 2)**.

When looking at soybean in terms of maturity (early, medium and late maturity varieties) the medium maturing type had the highest mean germination percentage (54.32%) followed by late maturing material which the Early maturing type has the least germination percentage **(Table 3)**. Highest germination index (GI) and germination rate index (GRI) was recorded in early maturing soybean varieties.

Table 3. Mean germination characteristics of soybean type stored for seven months in Makurdi.

Variety type	G%	GI	GRI
Early maturing	38.84	2.18	6.5
Medium maturing	54.32	1.89	2.8
Late maturing	39.76	1.63	2.5

The presence of mycoflora found on soybean differs among fungi and soybean varieties. Higher percentage of *Aspergillus niger* was recorded in soybean variety TGX 1842-1E also TGX 1842-1E did not record any presence of *Fusarium* spp. and *Botraodiplodia theobroma*, *Aspergillus niger* was not found in soybean varieties TGX 1869-13E, TGX 1895-35F, TGX 1894-3F, TGX 1802-1F and TGX 1878-7F. Soybean variety TGX 1440-IE recorded higher percentage of *Aspergillus flavus*. Soybean varieties TGX 1890-7F, TGX 1895-35F, TGX 1878-7F and TGX 1802-3F did not record the presence of Aspergillus *flavus.* Doko soybean variety gave higher percentage of *Fusarium* spp., *Corcospora kikuchi* and *Botraodiplodia theobroma*. There was no occurrence of any fungi organism in soybean variety TGX 1895-35F **(Table 4)**.

Table 4. Percentage occurrence of fungi organism found on twenty varieties of soybean stored for seven months in Makurdi.

Varieties	*Aspergillus niger*	*Aspergillus flavus*	*Fusarium* spp.	*Corcospora kikuchi*	*Botraodiplodia theobroma*
TGX 1805-31F	2.3	1.2	5.3	3.0	0.0
TGX 1844-18E	2.8	1.8	4.5	1.2	5.0
TGX 1890-7F	5.0	0.0	2.5	3.0	1.7
TGX 1838-SE	1.1	0.3	5.6	2.3	8.3
TGX 1440-IE	2.2	13.0	0.0	1.7	11.1
TGX 1844-43	6.1	3.5	0.0	1.1	0.0
TGX 1895-35F	0.00	0.0	0.0	0.0	0.0
TGX 1869-13E	17.0	8.9	2.3	0.7	0.0
TGX 1842-1E	32.3	1.0	0.0	2.4	0.0
MILENA	1.7	3.9	0.0	4.4	23.9
TGX 1880-3E	6.3	5.0	27.5	8.5	0.0
TGX 1894-3F	0.00	5.1	0.0	4.1	0.0
TGX 9223-2E	6.4	4.0	0.0	7.0	15.5
TGX 1873-16E	1.8	3.3	1.5	7.2	3.0

TGX 1866-12F	4.2	0.8	11.3	2.8	12.2
DOKO	0.9	7.4	37.6	33.4	13.3
TGX 1802-1F	5.1	6.5	6.7	6.1	6.1
TGX 1878-7F	0.00	0.0	0.0	2.1	0.0
TGX 1802-3F	0.00	0.0	1.1	4.5	0.0
TGX 1896-3F	4.6	4.2	1.0	4.6	0.0

Percentage infection of *Fusarium* spp. fungi disease found on 20 varieties of soybean was more prominent than the other fungi diseases investigated **(Table 5)**. Invasion of seeds by storage fungi may result in loss of viability, an increase in free fatty acids and decrease in non-reducing sugars. Among the mycoflora observed during storage of soybean seed, the *Aspergillus* spp. occupied the major percentage in early maturing soybean varieties **(Table 6)**. This result indicated that early maturing soybean varieties were more susceptible to all fungi diseases investigated.

Table 5. Percentage infection of fungi disease found on twenty varieties of soybean.

Fungi Disease Types	Soybean Variety
Aspergilus niger	19.69%
Apergillus flavus	19.71%
Fusarium spp.	21.09%
Cercospora kikuchi	19.75%
Botryodiplodia theobromae	19.75%

Table 6. Percentage occurrence of fungi organisms found on twenty varieties of soybean.

Variety	*Aspergillus niger*	*Aspergillus flavus*	*Fusarium* spp.	*Corcospora kikuchi*	*Botraodiplodia theobroma*
Early maturing	1.3	20.65	18.8	18.9	18.6
Medium maturing	2.39	2.24	5.02	4.63	1.91
Late maturing	5.42	4.53	2.39	2.39	5.48

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