

## Seeds germination of *Guizotia abyssinica* (L.f.) Cass. stored in different environments and packages

Germinação de sementes de *Guizotia abyssinica* (L.f.) Cass. armazenadas em diferentes ambientes e embalagens

Germinación de semillas de *Guizotia abyssinica* (L.f.) Cass. almacenadas en diferentes ambientes y embalajes

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### Abstract

Seed quality is defined by several factors such as genetic, physical, physiological and sanitary attributes. Even with all good factors involved, germinating power loss occurs. However, this loss may be reduced by performing procedures to maintain quality, as storage local and packaging. Thus, the objective of the work was to identify the best environment and packaging for storing niger seeds by analyzing germination and seedling biometry. Samples were separated according to treatments being three types of packaging: paper bag (permeable), plastic bag (semi-permeable) and glass container (impermeable). All packages were storage in two environment: storage shad and cold chamber. For all evaluations sub-samples were removed of each type of pack and environment being at one day after harvest (control), 30, 60, 90, 120 and 150 days of storage. The work was conducted at Laboratory of Seed Technology of Grand Dourados Federal University (UFGD). The experimental design was completely randomized, in a factorial scheme  $6 \times 6$  (treatments x days of storage), with four replicates of 50 seeds each. Sowing was performed between "germitest" papers and rolls were kept in a germinator at a temperature of 25°C under constant white light, for 10 days. The traits evaluated were: first count of germination, percentage of germination and seedling length. Storage locations and type of packaging interfered significantly to development of niger (*Guizotia abyssinica* (L.f.) Cass.) seed germination. The best results in germination were found in seeds stored in glass container in storage shed and in plastic bag in cold chamber.

**Keywords:** Vigour test; Niger seeds; Seed storage.

### Resumo

Qualidade de sementes é definida por diversos fatores como atributos genéticos, físicos, fisiológicos e sanitários. Mesmo com todos os fatores bons envolvidos, a perda do poder de germinação ocorre. Entretanto, esta perda pode ser reduzida por meio de procedimentos que mantenham a qualidade como o local de armazenamento e a embalagem. Assim, o objetivo do trabalho foi identificar o melhor ambiente e embalagem para o armazenamento das sementes do níger por meio da análise da germinação e da biometria das plântulas. As amostras foram separadas de acordo com os tratamentos, sendo três tipos de embalagem: saco de papel (permeável), saco plástico (semipermeável) e recipiente de vidro (impermeável). Todas as embalagens foram armazenadas em dois ambientes: galpão de armazenamento e câmara fria. Para todas as avaliações foram retiradas subamostras de cada tipo de embalagem e ambiente sendo um dia após a colheita (controle), 30, 60, 90, 120 e 150 dias de armazenamento. O trabalho foi realizado no Laboratório de Tecnologia de Sementes da Universidade Federal da Grande Dourados (UFGD). O delineamento experimental foi

inteiramente causalizado, em esquema fatorial  $6 \times 6$  (tratamentos x dias de armazenamento), com quatro repetições de 50 sementes cada. A semeadura foi realizada entre papéis "germitest" e rolos mantidos em germinador à temperatura de  $25^\circ\text{C}$  sob luz branca constante, por 10 dias. As características avaliadas foram: primeira contagem de germinação, porcentagem de germinação e comprimento de plântula. Os locais de armazenamento e o tipo de embalagem interferiram significativamente no desenvolvimento da germinação de sementes de níger (*Guizotia abyssinica* (L.f.) Cass.). Os melhores resultados na germinação foram encontrados em sementes armazenadas em recipiente de vidro em galpão de armazenamento e em saco plástico em câmara fria.

**Palavras-chave:** Teste de vigor; Sementes do níger; Armazenamento de sementes.

### Resumen

La calidad de la semilla se define por varios factores como los atributos genéticos, físicos, fisiológicos y de salud. Incluso con todos los buenos factores involucrados, se produce la pérdida de poder de germinación. Sin embargo, esta pérdida se puede reducir mediante procedimientos que mantengan la calidad, como el lugar de almacenamiento y el embalaje. Por lo tanto, el objetivo del trabajo fue identificar el mejor ambiente y empaque para almacenar semillas de níger mediante el análisis de la germinación y la biometría de las plántulas. Las muestras se separaron según los tratamientos, con tres tipos de empaque: bolsa de papel (permeable), bolsa plástica (semipermeable) y recipiente de vidrio (impermeable). Todos los paquetes se almacenaron en dos ambientes: galpón de almacenamiento y cámara frigorífica. Para todas las evaluaciones, se retiraron submuestras de cada tipo de empaque y ambiente, un día después de la cosecha (control), 30, 60, 90, 120 y 150 días de almacenamiento. El trabajo se llevó a cabo en el Laboratorio de Tecnología de Semillas de la Universidad Federal de Grande Dourados (UFGD). El diseño experimental fue completamente causalizado, en un esquema factorial  $6 \times 6$  (tratamientos x días de almacenamiento), con cuatro repeticiones de 50 semillas cada una. La siembra se llevó a cabo entre papeles "germitest" y rolos mantenidos en un germinador a  $25^\circ\text{C}$  bajo luz blanca constante, durante 10 días. Las características evaluadas fueron: primer conteo de germinación, porcentaje de germinación y longitud de plántula. Los lugares de almacenamiento y el tipo de empaque interfirieron significativamente en el desarrollo de la germinación de las semillas de níger (*Guizotia abyssinica* (L.f.) Cass.). Los mejores resultados en germinación se encontraron en semillas almacenadas en un recipiente de vidrio en un cobertizo de almacenamiento y en una bolsa de plástico en una cámara fría.

**Palabras clave:** Prueba de resistencia; Semillas de níger; Almacenamiento de semillas.

## 1. Introduction

Niger (*Guizotia abyssinica* (L.f.) Cass.), also called Ramtil or Kalatil in India and Noog in Ethiopia is considered a crop with satisfactory oil and seed yield under poor conditions of soil fertility, moisture stress and low managements (Namarata et al., 2018), furthermore, this species is sowing in large scales in mentioned countries.

In Brazil, niger highlighted as a promissory crop for bio fuel production as it count with oil content between 30 – 45%, with high content of phospholipids and high concentration of linoleic acid (71.7%) (Ramadan & Mörsel, 2003).

Despite this, there is lack of information on physiological quality in which niger seeds are produced, especially regarding to seed germination. This information is scarce due to methods of analysis not included in the Brazilian Rules for Seed Analysis, which also occurs with other exotic species with bio fuel potential (Souza et al., 2009; Gordin et al., 2012; Gordin et al., 2014).

In addition, one of the problems faced in production and subsequent availability of seeds for sale is the knowledge about storage possibilities. This constitutes an essential requirement for genetic resources conservation in germplasm banks and, especially, to facilitate seeds production logistics and commercialization of established cultivars (Carvalho et al., 2017).

Evaluation of seed germination in response to different moisture levels, exposure to different temperatures and pre-germinative treatments are essential for definition of the best storage strategies, and the most important: the period in which these seeds are still viable for field emergency work. Being this, a possibility of the most accessible, becoming with that, the most attractive for producer and for research institutions (Carvalho et al., 2017).

Surely, the responses to storage are intrinsic to each species, and in many cases there may be variations within the species itself in relation to different varieties or cultivars, therefore, researches about this subject are important.

When choosing the ideal place for storage, it is also necessary to worry about the packaging in which the seeds will be placed, as if it is not hermetically closed there will be action of external agents that will cause damages to seeds, mainly pests.

The process of seeds packaging may provide a protective environment against changes in humidity avoiding damages that may be caused by sudden variations of environment temperature. In this way, seeds stored in suitable packaging can have longer longevity remaining viable for longer time (Carvalho et al., 2017).

Thus, the objective of this work was to evaluate the germination of niger (*Guizotia abyssinica* (L.f.) Cass.) seeds stored in different environments and packaging.

## 2. Methodology

The seeds of niger (*Guizotia abyssinica* (L.f.) Cass. - Asteraceae) used were collected from 2018 harvest cultivated at Experimental Farm of Agrarian Science, belonged to Gand Dourados Federal University, in the municipality of Dourados, Mato Grosso do Sul State, Brazil. The chapters harvesting and threshing were performed manually, and then the achenes were homogenized composing a single lot.

After this stage, samples were separated according to treatments being three types of packaging: paper Kraft bag (as permeable type), plastic bag (as semi-permeable type) and glass container (as impermeable type).

In relation to locals of storage, treatments were stored in a storage shed, commonly used for seed storage with non-controlled temperature and air humidity and cold chamber. For the first local, temperature and humidity were taken every day using digital thermohygrometer, which showed the maximum and minimum temperature and humidity during an established period of time, in this case in each 24 hours. The maximum and minimum mean temperatures were 34.6 °C and 20.7 °C, respectively and maximum and minimum relative air humidity were 82.4% and 38.1%, respectively. In relation to cold chamber, temperature and humidity were constant being 14°C of mean temperature and 30% of humidity.

For all evaluations, sub-samples were removed of each type of pack and environment being at one day after harvest (control), 30, 60, 90, 120 and 150 days of storage (DOS).

The work was conducted at Laboratory of Seed Technology, at Faculty of Agrarian Sciences of Grand Dourados Federal University (UFGD). The experimental design was completely randomized, in a factorial scheme  $6 \times 6$  (treatments x days of storage), with four replicates of 50 seeds each.

Sowing was performed between “germitest” papers moistened to 2.5 times the dry mass (g) of substrate. The paper rolls were kept in a B.O.D. (Biochemical Oxygen Demand) germinator type at a temperature of 25°C under constant white light, for 10 days inside plastic bags (Brasil, 2009).

The traits evaluated were: first count, considering germinated seeds with 2 mm of primary root, five days after sowing with values transformed into percentage; percentage of germination, at the end of test (10 days after sowing – DAS), obtained considering the formation of normal seedlings (those which presented aerial part and developed root system) and seedling length, estimated using a centimetric ruler in which 10 seedlings were measured per treatment. The total length was measured from the apex of the largest primary root to the end of the primary leaves. The results were expressed in millimeters per seedlings.

The values of first count, germination percentage and seedling length were tested for residue normality and homogeneity among the variances, submitted to analysis of variance and in the case of significance at 5% of probability the means were compared by Skott-Knott test by Sisvar computer program (Ferreira, 2019).

### 3. Results and Discussion

There was interaction between storage location and packaging treatments with niger seed storage periods for percentage of first count as shown in Table 1.

**Table 1.** First count, five days after sowing (DOS), of *Guizotia abyssinica* (L.f.) Cass. germinated seeds, according to seedlings with 2 cm of formed root system in different storage local and package over time.

		First count (%)					
		Days of storage (DOS)					
Local	Package	0	30	60	90	120	150
Storage shed	Paper	18.4 a A	17.5 b A	14.0 d B	17.4 a A	16.4 b A	11,9 c C
	Plastic	18.4 a A	18.8 a A	18.5 c A	18.5 a A	18.6 a A	14.4 b B
	Glass	18.4 a A	19.4 a A	16.0 c B	18.5 a A	17.6 b B	17.4 a B
Cold chamber	Paper	18.4 a B	19.0 a B	21.3 a A	18.6 a B	20.0 a A	16.7 a B
	Plastic	18.4 a A	19.8 a A	16.0 c B	18.6 a A	17.8 b A	16.5 a B
	Glass	18.4 a B	17.4 b B	16.9 c B	17.6 a B	20.0 a A	17.0 a B
CV(%)		7.54					

Means followed by the same lowercase letter in the column and uppercase letter in the row do not differ at the 5% probability level by Scott-Knott test. Source: Authors.

Analysing treatments into each period of storage, it was verified that there was no statistical difference among treatments at control (day zero) and 90 days of storage (DOS). In relation to other periods at 60, 90, 120 DOS seed stored in cold chamber into paper bags presented the highest mean, which have differed statistically from all other treatments, while the lowest mean was observed in seeds stored in storage shed into paper bags. At the end of experimental period, the worst mean continued to be seed, which have been stored in storage, shed into paper bag.

When treatments are compared over the time, it is possible to note that all of them decreased the percentage of first count. From day zero (Control) until 150 DOS the highest decreased of this trait mean was observed for seed in storage shed into paper bag, with reduction of 35.8% and the lowest reduction was noted in storage shed into glass container (5.4%).

The assessment of physiological quality is an important component in health programs for quality control to ensure satisfactory seed performance and this quality is estimated routinely by applying tests such as first germination count, which may be efficient to determine seeds vigour (Guedes et al., 2015; Silva et al., 2018).

For the results observed at present research, the paper bag showed different behaviour into different locals, which means that the temperature and humidity might have influenced germination process, as the material of packages was the same. The mean temperature in storage shed was 27.7 °C and cold chamber was 14 °C.

In relation to percentage of germination there was significant difference for interaction between treatments ans storage period (Table 2). Analysing each time of storage it is possible to note that there was no statistical difference for day zero, 30 and 90 DOS.

**Table 2.** Percentage of germination, ten days after sowing (DOS), of *Guizotia abyssinica* (L.f.) Cass. germinated seeds, according to normal seedlings in different storage local and package over time.

		Germination (%)							
		Days of storage (DOS)							
Local	Package	0	30	60	90	120	150		
Storage shed	Paper	67.0 a A	73.0 a A	58.0 c B	69.0 a A	63.3 b A	52.5 c B		
	Plastic	67.0 a B	78.0 a A	74.8 a A	74.0 a A	78.5 a A	70.0 b B		
	Glass	67.0 a B	70.5 a B	65.0 b B	68.0 a B	73.0 a A	78.0 a A		
Cold chamber	Paper	67.0 a A	72.0 a A	71.8 a A	66.0 a A	70.0 a A	69.0 b A		
	Plastic	67.0 a B	78.5 a A	58.0 c C	66.0 a B	72.0 a A	74.0 a A		
	Glass	67.0 a B	75.3 a A	66.0 b B	67.3 a B	73.8 a A	70.0 b B		
CV(%)				6.91					

Means followed by the same lowercase letter in the column and uppercase letter in the row do not differ at the 5% probability level by Scott-Knott test. Source: Authors.

At 60 DOS, seeds stores in paper bag in storage shed and plastic bag in cold chamber presented the lowest means, differing statistically from all other treatments. Four and five months after harvest (120 and 150 DOS), seeds store in paper bag in storage shed have shown the smallest means of seed percentage (Table 2).

For analysis over the time of treatments, we may see different behaviours for each type of package and storage location. All treatments increased the germinations percentage at the end of experiment, except seed stored in storage shed and paper bag, which reduced in 21.6% the germination. In relation to the increment, the variation was from 3% (paper bag in cold chamber) to 16.4% (glass container in storage shed).

The final results of germination (Table 2) did not follow the tendency of first count (Table 1), in which decreased over the time for the second trait. This information is important to show that first count percentage, even being easy to quantify, did not present the real seed vigour by itself.

It is important to advise that there is few information about the studied subject in the literature, which means that more research should be done to increase information about niger seed storage.

In work with *Crambe abssynica*, Amaro et al. (2015) found significant results when seeds were stored in plastic bag, the same in present data, where in both storage local, plastic bag increased the germination rate at the end of experiment. They also reported that, for all tried packaging, the values of germination percentage found were below the standard established for seeds commercialization of other oilseeds species, such as canola (*Brassica napus* L. var. *oleifera* Metzg) which is 80% germination (Brasil, 2009b).

Low values of germination found in the present work may be associated to post harvest dormancy present in seeds, common mechanism present in seeds of different species (Brasil, 2009a).

Even presenting low germination to all treatments, niger seed presented better vigour when submitted to storage in semi-permeable (plastic bag) and impermeable (glass container) packages in all studied locals. Cardoso et al. (2012), when tested the germination of *Crambe abssynica* seeds stored in impermeable package, found the same as in the present work.

The temperature and humidity should have interfered at germination rate as in cold chamber the final result presented higher general means in relation to storage shed. During experiment, the temperature of storage shed was 27.7 °C, while

humidity was 60.3% and in cold chamber, the temperature was constant in 14 °C and humidity of 30%. It is important to mention that in storage shed, there was not temperature and humidity control, which means that the variation from one day to another could be high and this oscillation may damage the seeds.

According to Carvalho and Nakagawa (2012), the best conditions for maintaining seeds quality, are low relative humidity and low temperature. Under these conditions, the embryo maintains less metabolic activity. In this case, semi-permeable and impermeable packages reduced the gas exchange between seed and outside environment, in addition to prevent pests and diseases entrance.

For seedling length also was found significant difference in relation to interaction between storage location and package to period of storage (Table 3).

**Table 3.** Seedling length, ten days after sowing (DOS), of *Guizotia abyssinica* (L.f.) Cass. germinated seeds, according to normal seedlings in different storage local and package over time.

		Seedling length (cm)						
		Days of storage						
Local	Package	0	30	60	90	120	150	
Storage shed	Paper	14.9 a A	13,8 a A	11.6 a B	10.7 b B	11.5 a B	15.3 a A	
	Plastic	14.9 a A	14.1 a A	10.3 a C	11.7 a B	12.6 a B	15.5 a A	
	Glass	14.9 a A	15.8 a A	9.9 a B	10.7 b B	9.1 b C	8.2 b C	
Cold chamber	Paper	14.9 a A	11.6 b C	9.8 a D	12.6 a B	11.3 a C	9.5 b D	
	Plastic	14.9 a A	14.6 a A	7.6 b C	12.5 a B	11.5 a B	9.0 b C	
	Glass	14.9 a A	15.3 a A	10.4 a C	12.9 a B	10.8 a C	8.1 b D	
CV(%)		9.32						

Means followed by the same lowercase letter in the column and uppercase letter in the row do not differ at the 5% probability level by Scott-Knott test. Source: Authors.

The effect of storage time on seedling length have different behaviour in each time. At 30 DOS seeds stored in cold chamber in paper bag presented the smallest seedlings. In two months of storage (60 DOS), seeds in cold chamber and plastic bag presented the lowest means, at 90 and 120 DOS glass container into storage shed showed smaller means and at five months of storage the treatment stored in cold chamber and glass container was the lowest.

Over the storage time, only two treatments have increased seedling length. Despite of increasing, the rate was low being 4% for seeds stored in storage shed in plastic bag and 2.7% in seeds stored in the same location in paper bag. All other treatments, have decreased in high rates being the highest decreasing seeds stored in cold chamber and glass container (45.6%).

Vange et al. (2016) found that packaging material affect initial seedling traits as total length, in soybean development. However, the same work did not presented statistical difference to percentage germination. The same authors explained that cold storage tend to increase seed quality, as cold diminish seed metabolism, which may conserve the properties.

In spite of being the highest length (Table 3), seeds stored in storage shed in paper and plastic bags presented low means for first count (Table 1) and germination (Table 2). As concluded previously, niger seeds may have some degree of



dormancy, which impaired germination process, otherwise, when seed achieved the beginning of this process during evaluated period, it may report that the seed potential was conserved.

#### 4. Conclusion

Storage locations and type of packaging interfered significantly to development of niger (*Guizotia abyssinica* (L.f.) Cass.) seed. The best results in germination were found in seeds stored in glass container in storage shed and in plastic bag in cold chamber.

This diversification of local and package is well received as producers may have more options to store productivity to use in the next growing season.

Taking everything into consideration, it is important to highlight that even in great conditions the power of germination will decreased as it is concerned to seed nature. However, several factors may influenced the improvement of seed longevity, as temperature, oxygen, relative air and, moisture content and mainly the species

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