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Harvest season and physiological quality of *Enterolobium schomburgkii* seeds. Benth.

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Abstract. The objective of this research was to evaluate the physiological quality of seeds *Enterolobium shomburgkii* collected in different months of the year 2014. There were made fruit harvests from trees located in the urban area of Sinop-MT, in the months of June, July, August and September. In each crop was rated the number of seeds per fruit, weight of 1,000 seeds, water content of the seeds, dry weight, germination percentage, germination speed index and it was also appliedthe electrical conductivity test. The results show that the harvest of *Enterolobium schomburgkii* seeds should be held in August and September.

Keywords: Dormancy, Faveira, Germination, electrical conductivity.

Introduction

Enterolobium schomburgkii is native from South and Central America. It has a wide geographical distribution in the neotropical area.It can be found in differentes regions such as Central America, Legal Amazon and also in the Northeastern, Southeastern and South parts of Brasil, spreading by Argentina, Peru, Uruguay, Paraguay, Bolivia and Bolivarian Republic ofVenezuela.*E. schomburgkii*is a tree between 10-50 m that inhabits non-flooded evergreen forest. It is one of the leguminosae that makes association with the nitrogen-fixing bacteria. (Mesquita, 1990).

The fruit of *E. schomburgkii* was described by Mesquita (1990) in his revision of type, as indehiscent, contorted, brown to black and sublenhosa consistency, with 3-4 cm in diameter and 1-3 cm thick. The epicarp has glabra surface; the mesocarp has fibrous consistency woody and brown color; and the cored is whitish. The seed is elliptical, sulfur-yellow color, with dimensions 0.7 cm long by 0.4 cm wide.

Souza & Varela (1989) mention that the seed of the species have physical dormancy caused by the impermeability of the seed peel to water, requiring the application of scarification treatments.

One of the main problems to obtain forest seeds it is thefruits production seasonality. The fact that the species bear fruit periodically at intervals may be regular or irregular, difficult the obtaining of a high quality seeds. Beyond needing to know which is the period in which a species produces seeds, it must be understood the factors that could influence this behavior.

The study of physiological maturity of seeds brings about the fact of defining the exact time of collection and the peak of quality, called physiological ripening. It canvary depending on the species and environmental conditions, being necessary to set parameters for a right definition about the time of collection, called maturation rates (Popinigis, 1985). Practical parameters may represent the fruit or/and seed development stage g.

The physiological ripening reached when the seed gets the maximum weight of dry matter and shows marked reduction in water content, is accompanied by visible changes in the external appearance of fruits and seeds (Carvalho& Nakagawa, 1988).

The irregularity of the seeds productions can be manifested at different scales: a) species that produce annually or in regular intervals; b) the ones that has long periods without production within the productive years and c) those in which take place peaks of production followed by a period of an irregular production. (Piña-Rodrigues & Jesus, 1991). The years without production can be as a result of the necessity of the specie to safe resources for the vegetative growing.

For studies of the physiological seed quality was evaluated the percentage of germination, germination speed index, biochemical tests (electrical conductivity test, tetrazolium test, potassium leaching breath test) the stress resistance tests (accelerated aging, controlled deterioration, cold test and others).

The available literature lacks of information about the phenology of production of fruits and seeds, harvest time associated with the physiological quality of *E. schomburgkii* seed. The objective of this research it has been to evaluate the physiological quality of seeds *Enterolobiumshomburgkii* collected in different months of the year.

Methods

The fruits were collected directly from the ground in the months of June, July, August and September of 2014 in the forest park in the municipality of Sinop - MT (S 11 50 '04.1' ', W 055 ° 29' 56.7 ", 375 m); and taken to the seed Technology Laboratory of the Federal University of MatoGrosso, Campus Sinop, MT, dried at shadow, and the seeds processed manually. Each lot was stored in closed glass pots and put in a freezer at a (6 to 9 degree) oftemperature and 70% of humidity. There were made the following precedures:

-Number of seeds per fruit: 100 selected at random from each harvest.

-Weight of one thousand seeds:there were used eightsubsamples from 100 seeds in analytical balance Mars, AY 220 model, according to the Seed Analysis for Rules - RAS (Brazil, 2009).

-Seeds humidity degrees: it was used eight subsamples from 50 seeds, by the oven method at 105 ° C ± 3 ° C for 24 hours followed RAS (Brazil, 2009).

-Dry weight of the seeds: Found together with the water content, the percentage of dry matter was obtained from the relationship between the dry matter weight of the final and initial weight (wet weight) with the results expressed in grams.

- Germination: For the technique of the seed overcoming dormancy, was used the lateral mechanical scarify treatment with sandpaper. Four repetitions of twenty-five seeds from each batch were placed in boxes containing moistened Gerboxgermitest paper, taken to germinating (BOD) at a temperature of 30°C and 12 hours light. During the test period the substratum was humidified with a manual spray and a daily counting was carried out together with the germination test for 5 days.

- GerminationSpeed Index (GSI): The speed of germination rate was calculated from the mean values obtained for four samples of 25 seeds (Brazil, 2009).

- Electrical conductivity (EC): There were used five replications of 50 seeds of each month, which were previously weighted in analytical balance Mars, AY model 220 with an accuracy of 0.001 g.Each repetition was wrapped in plastic cups (250 ml) containing 75 ml of deionized water, and subsequently subjected to 2, 4, 6, 12, 24, 48, 72 hours of imbibition at 25 ° C. After each soaking period, it performed the EC reading in soaking solution of the seeds using a benchtop conductivity meter, brand Marconi, CA-150 model, with constant 1.0. The value of each conductivity reading was divided by its weight of the sample, expressing the results of electrical conductivity in $\mu S\ cm^{-1}\ g^{-1}$ seed.

The germination percentage and speed were analyzed using a completely randomized design with four replicates per treatment (batch) and the averages were compared by Tukey test at 5% probability. The germination percentages of results (G) were transformed into arc for statistical analysis.

For the Conductivity Electrical Test, the data were analyzed according to completely randomized design individually for each soaking period, with 4 treatments (months) and five repetitions of 50 seeds. The average each month conductivity were compared by Scott-Knott test at 5% of probability. Statistical analysis was performed using the ASSISTAT-BETA version 7.7 software.

Results and discussion

The number of seeds per kilogram varied from 29,013.54 to seeds from June to 15734.37 seeds collected in September (Table 1). The average value for the number of seeds per kilogram was 17080.89, being lower than the results reported by Varela & Souza (1989), which mentions 21,607 *E. Schomburgkii* seeds per kilogram.

The weight of one thousand seeds ranged from 34.46 g to seeds collected in June to 63.555 g for seeds collected in September 2014 (Table 1). The weight of a thousand seeds averaged 51,21g, less those presented by Ramos et al. (2008) and higher than the results of Souza and Varela (1989) who recorded 53,6g and 46g respectively.

The variation in the number of seeds per kilogram and thousand seed weight between the months of harvest is in agreement with Aguilar et al. (1993), that the seed production can be affected by genetic characteristics and environmental conditions during its formation process, resulting in variations between lots of different years of fruiting and from different matrices collection.

The humidity degree content in the seeds, showed significant variations between samples, being higher in June and July (Table 1). At the time the seeds were ripening, there was a fall ofthe water content. The reduction of the seed water content was explained by Carvalho& Nakagawa (2000) as follows: the seed, shortly after having been formed zygote typically has a high moisture content, to then start a phase slow decrease. This phase has a variable duration according to the species and climatic conditions, and then followed by a phase of rapid dehydration to oscillate with humidity values of the air, demonstrating that, from that point, the mother plant, do not has control over the seed moisture content.

The accumulation of dry matter in seeds had significant variation, being higher in August and September due to the accumulation of proteins, lipids and carbohydrates in seeds, resulting in an increase in weight of dry matter close to ripeningpreocess. According Popinigis (1985) the "point of physiological ripening", is one in which the seeds have the maximum physiological quality, resulting in a maximum dry mass value, germination and vigor.

Barros (1986) describes this period as one in which the seeds will fall off the mother plant, stops translocation of photosynthesis and, since this very moment, there are physiological changes that promote the dehydration of the seeds. According to Carvalho& Nakagawa (2000) in seed ripening studies, must be considered as the features of physical and physiological nature, such as size, water content, dry weight, seed germination and vigor.

Germination started soon on the second day.The results shows that the highest percentage of germination occurred in August (100%) and September (98%) of 2014 (Table 1), with no significant differences in germination between August and September.

The germination rate index behaved similarly to germination, with the highest values recorded for the seeds in August (9.20) and September (7.0) 2014 (Table 1).There was a higher germination the third and fourth day.

The results of the electrical conductivity showed that 75 ml of water using 50 seeds can be separated along all times tested the four seed lots, corroborating the results of germination and speed percentage (Table 2). There was a variation in the electrical conductivity (EC) between batches in all periods, and the coefficients of variation ranged from 43.07% (June) toa very high 264.94% (June).

It was verified that the batch of August had the lowest EC values in all periods of soaking. The electrical conductivity test indirectly measures the concentration of electrolytes released by the seeds during soaking. Researches made with several species have shown that the reduction and loss of physiological quality are directly proportional to the increase of the concentration of electrolytes released by the seeds during imbibition (Dias & Marcos Filho, 1996; Loeffler et al., 1988).

The amount of exudates leached seeds in water imbibition can be influenced by the degree of deterioration, the growth stage at harvest and the incidence of damage caused by the imbibition rate (Loeffler, 1981), by temperature and time imbibing (Powell, 1986) and injuries in the seed peel. It was noticed also that even with lower EC value, the batch of August appears among the top performers in the germination test (Table 1), which should normally be expected. The conductivity values will be low when the seed quality is high.

The maximum germination capacity and the most significant increases in force, expressed by the emergence speed index (Table 1) and the electrical conductivity test (Table 2), was applied in August and September after reaching the highest weight of matter dry seeds. These results suggest that the germination and seed vigor are responses to the accumulation of dry matter, which can be manifested for a certain period of time after the maximum weight of dry seeds is reached

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Table 1. Moisture Level (% U), dry matter (DM), number of seeds per kilogram (Qty / kg) weight of thousand seeds (g) (P), germination (G%) and speed of germination index (IVG), *Enterolobium schomburgkii* from the trees in the months of June, July, August and September 2014).

Month	% U	MS	Amount / Kg	Thousand seed weight	G (%)	IVG
June	9,86a	90,13a	29.013,54	34,47	47 a	3,47 a
July	9,12b	90,87a	16.666,67	60	60b	6,50b
Aug	7,52c	92,48b	15.909,09	62,85	100c	9,20c
Sept	6,47d	93,53b	15.734,27	63,55	98c	7,0d

Means followed by the same letter, tiny column, do not differ by Tukey test at 5%.

Table 2. Electrical conductivity (µS c^{-1} g^{-1}) of lots of seeds June, July, August and September *E. shomburgkii* soaked in 75 mL of deionized water for different periods at 25 ° C.

	CE										
Month	2h	4h	6h	12h	18h	24h	30h	36h	42h	48h	72,h
June	6,7a	7,45ª	10,09ª	13,1ª	22,09ª	26,65ª	30,3ª	45,12ª	59,08ª	54,12ª	62,07ª
July	5,3b	8,7b	9,98b	11,71b	13,98b	19,48b	25,39b	31,52b	36,26b	43,21b	45,54b
Aug	3,21c	4,34c	5,47c	6,6c	7,73c	8,86c	9,99c	11,12c	12,25c	13,38c	18,12c

Sept	4,87d	6,25d	7,63d	9,01d	10,39d	11,77d	13,15d	14,53d	15,91d	17,29d	22,31d

In Figure 1 it shows that with increasing time of imbibition there was good separation of seed lots. This separation is much sharper in batches I and II between batches III and IV was also good separation but with similar values among them. Electrical conductivity curves for the four lots shows a tendency to grow; this may be related to the soaking time.

These results agree with Marques et al. (2002a) which showed an increase in the electrical conductivity values imbibition's time, regardless of the incubation temperature and quality of the seed lot. Other authors cite this same behavior in several researches, Santos & Paula (2005) *Sebastiania commersoniana* seeds, Loeffler et al. (1988). Dias & Marcos Filho (1996) reported that for soybeans, the less pronounced the differences between the vigor of lots, there is a need for longer periods of imbibition to differentiate these lots.

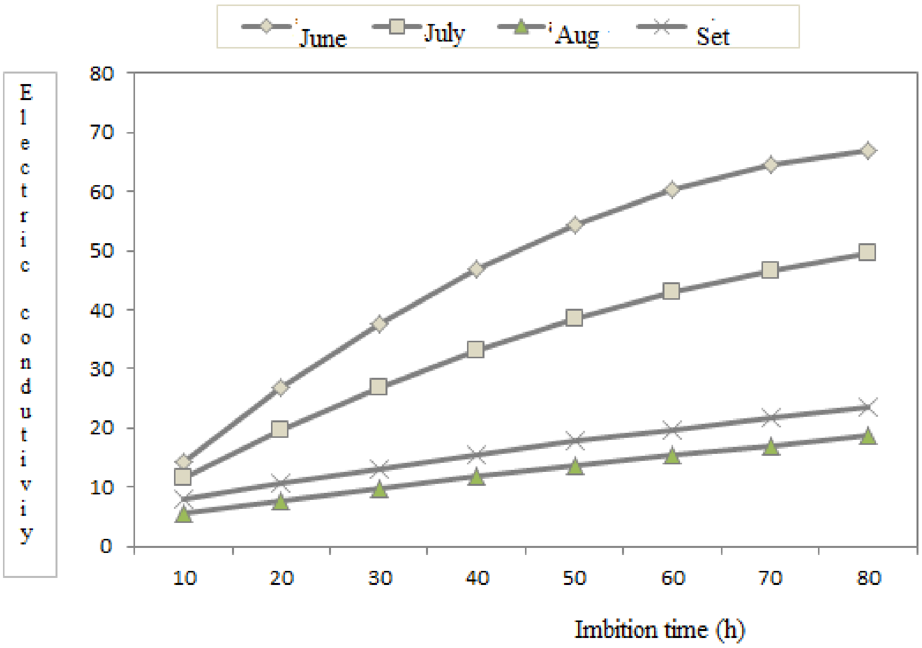

Figure 1. Electrical Conductivity (μS.cm^{-1}.g^{-1}) of the four lots of *Enterolobiumshomburgkii* seeds).Samples with five replicates of 50 seeds of each month soaked in 75 mL of deionized water for different periods of soaking.

Electrical conductivity test has been applied in forest seeds in order to adapt the methodology to different types of tree species, such as conifers, broadleaf and different successional groups.

Barbedo & Cicero (1998) found that the conductivity test was promising to differentiate seed lots of *Inga uruguensis* into three categories of germination; germination tests EC and presented positive correlation. Marques et al. (2002 b) found that using the electrical conductivity test showed satisfactory results for quality evaluation of physiology three seed lots *Dalbergianigra*. That test was also useful to differentiate the physiological quality of different batches of seeds *Sebastiania commersoniana* (Santos & Paula, 2005). Gonzales et al. (2011) also rated the physiological quality of seeds *Corymbia citriodora* with this test.

The results obtained in this research, may be related to the variability in the physiological quality of fruits and seeds, collected in different months where local variations in temperature and humidity are presented.

The species *Enterolobium shomburgkii* according to observations made, since 2009 by the Forestry Development group UFMT, Campus Sinop, has an alternation in the fruiting in several years. For the species were made fruit collected in the years 2009, 2010, 2012, 2013 and 2014. In 2014 when they were collected, fruits and seeds used in this work, the physiological seed quality evaluated by the germination percentage and rate of germination rate was higher in the months of August and September (Table 1).

The seeds showed impaired color from light brown green (Figure 2), according to Corvello (1999). This shows the reduction and subsequent termination of transfer of substances synthesized. It also confirms that the color of seeds, associated with other rates, is a feature that can be used as an indicator of physiological ripening of seeds.

The relationship betweenthe appearance of the fruit, main color, and the seed physiological ripening has been studied in forest species: Souza Junior et al. (2007) in *Calypthrantes clusiifolia*., Silva et al. (2009) *in Ricinus communis* L., Nogueira et al.

(2013) in *Mimosa caesalpiniifolia*,. Pessoa et al. (2010) in *Piptadenia viridiflora* (Kunth.) Benth. Mata et al. (2013) in *Inga Strita* expose this relationship.

The seed size can also influence the results of the test (Deswal & Sheoran, 1993) electrical conductivity. This test forest seeds unlikely to have the same result, is achieved in seeds of great cultures, but is a tool that can help, together with other tests of germination, in the identification of lots of different physiological qualities.

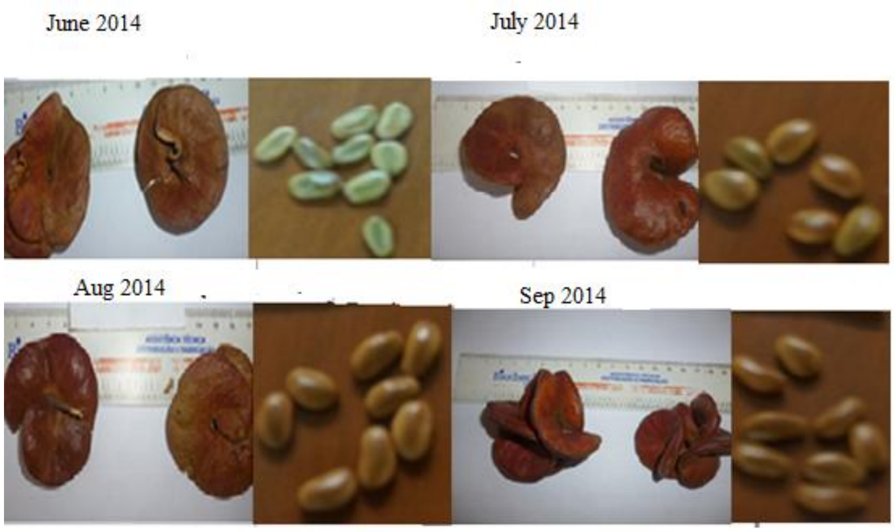

Figure 2. Seeds and fruits of *Enterolobium schomburkii* collected in June, July, August and September 2014

Conclusions

There was better germination rates in seeds collected in August and September. The conductivity test is promising for differentiation of the physiological quality of batches of *Enterolobium shomburgkii* seeds may be conducted at 25°C, using 50 seeds soaked in 75 ml of water for 72 hours.

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