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Physiological maturity of seeds of *Cedrela fissilis*

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Abstract: *Cedrela fissilis Vell is known as cedar, is an arboreal species and has great economic importance due to its extensive use. The seeds are the way to spread more used in the deployment of forests, so important to the knowledge of the physiological maturity. The research aimed to verify if the degree of maturation of the seeds of C. fissilis influences in their quality, by means of tests of germination and seed vigor. The seeds were classified into three stages of maturation, determined in accordance with the Charter of colors: 5 YR 6/8; 5 YR 4/6 and 2.5 YR 3/4. To verify the effects of maturation stages, carried out the following: weight of a thousand seeds, germination test, accelerated aging and performance of seedlings. The experimental design was a completely randomized. The maturation stages of seed resulted in significant effects in the mass of a thousand seeds, germination percentage and germination speed index.The accelerated aging test was efficient for classification of levels of seed vigor of C. fissilis in different maturation stages of the maturation stage of seed bearing on the quality of seedlings.*

Keywords: *Cedar, forest seeds, physiological maturity, potential physiological.*

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I. Introduction

Cedrela fissilis Vell, is a species of the Meliaceae family, known as cedar, is a native tree species in Latin America. It has great economic importance for Brazil, due to its extensive use. It is considered as secondary page, but can be located in primary forests in degraded soils [1; 2].

Specie considered to be of noble wood, possessing a great economic value, is widely used in landscape and its wood has various uses. However it is in danger of extinction, thus generating concerns, being a species in the composition of heterogeneous reforestation of degraded areas for conservation purposes [3; 4; 5].

The seeds are the way to spread more used in the deployment of forests, in virtue of being a quick and low-value, in this sense there is great importance in the study of the factors that interfere in the spread and influence of direct form in the spread of the species and the quality of seed [6].

The maturation of seeds can be characterized as a process resulting from morphological changes, physiological and functional that occurs since the fertilization of the egg until when they are ripe and ready to harvest [7]. Thus, the knowledge of the maturation process contributes to the establishment of the best time to collect seeds, enabling the best use, when it has better physiological quality [8].

Upon the exposed, the research aimed to verify if the degree of maturation of seeds of *Cedrela fissilis* influences in their quality, by means of tests of germination and seed vigor.

II. Materials And Methods

The experiment was carried out in the Laboratory of Seed Technology at the State University of the West of Paraná (UNIOESTE), Campus of Marechal Cândido Rondon, using seeds of *Cedrela fissilis*. The seeds were obtained from fruits harvested directly from headquarters located in the municipality of Marechal Cândido Rondon (24°32'42"S and 54°02'35"W, altitude of 420 m), composing a seed lot, and extracted manually. After, they were classified into three stages of maturation, determined in accordance with the Charter of colors, model Munsell color charts for plant tissues [9], In: 5 YR 6/8 (stage 1); 5 YR 4/6 (stage 2); 2.5 YR 3/4 (stage 3) (Table 1).

Table 1- Color of seeds of *C. fissilis* in diferent maturation stages.

Maturation stage	Color of seeds	Characteristic of the fruit	Munsell Manual of color
1		Fruit in transition from green to brown	5 YR 6/8
2		Brown fruit before the beginning of the dehiscence	5 YR 4/6
3		Brown fruit in beginning of the dehiscence	2.5 YR 3/4

It was determined the mass of a thousand seeds (MMS), carried out in accordance with the Rules for Seed Analysis RAS [10], with the weighing of 8 repetitions of 100 seeds per stage of maturation.

The germination test: The seeds were sown in plastic trays containing as sand substrate of autoclaved and stored in a germination chamber type BOD at a temperature of 25 °C constant and photoperiod of 12 hours. During the germination test were performed daily counts of normal and abnormal, with criteria determined by the RAS [10]. Based on the data obtained it was calculated, percentage of abnormal seedlings (PA), percentage of germination (G), first count of germination (FCG), germination speed index (GSI), average time of germination (ATG) and average speed of germination (ASG). For the first count of germination, we calculated the percentage of normal seedlings at the 14th day after the installation of the test [11]. The calculations de G, ATG and VMG were carried out in accordance with [12] and GSI according to [13].

Accelerated aging: the seeds were placed in Gerbox with mesh, containing 40 mL of water to ensure the level of relative humidity close to 100%.They were arranged in a uniform layer on the surface of the internal screen and taken to the house of aging, previously adjusted to constant temperature of 41 °C for 48 hours, according to [5].

Performance of seedlings: At the end of the germination test measured the length of hypocotyl (LH) and length of the radicle (LR) of normal seedlings, with the help of ruler, the results were expressed in cm, diameter at the base of the hypocotyl (DH), expressed in mm, measured with the aid of a digital caliper and number of leaflets, by means of counting. Then, the seedlings were separated into shoot and root system, placed in paper bags Kraft and taken to the greenhouse air circulation at 65 °C for 72 h after the samples were weighed on an analytical balance with a precision of 0.001 g, for obtaining dry matter of hypocotyl (DMH) and radicle (DMR) and the results expressed in grams.

The experimental design was a completely randomized, composed of three maturity stages and seven replicates containing 20 seeds. The results were submitted to the test of normality and homogeneity, followed by analysis of variance. Upon the significance of the data by F test were compared by Duncan test at 5% probability.

III. Results And Discussions

The averages obtained for the mass of a thousand seeds and for the parameters of germination of seeds of cedars can be viewed in Table 2.

It should be noted that the MMS ranged from 33.12 g to 45.16 g between the stages of maturation of seeds, where in stage 1 (5 YR 6/8) if obtained higher average. [14], obtained for the seed lot of cedar in his study, average weight of a thousand seeds equals 22.59 g, below the results obtained for the maturation stages investigated, and it can be inferred t.

For the first count of germination, percentage of abnormal seedlings, average germination time and average speed of germination, there was no significant difference between the treatments.

The highest germination percentages were observed for the maturation stages 1 and 2, with averages of 46% and 57%, respectively, these were similar, statistically, and superior to the third stage of maturation. As for the GSI there is a higher average for the treatment 5 YR 4/6 (stage 2), and statistical similarity between the averages observed for 5 YR 6/8 (stage 1) and 2.5 YR 3/4 (stage 3).

[15] observed there quadratic behavior of the germination percentage of seeds of *Mimosa caesalpiniaefolia* depending on the physiological maturation (days after anthesis), this result says that there is a difference in the germination of the seed according to the maturation stage, once the seeds assessed by these authors showed maximum germination in certain stage of maturation (178 days after anthesis), then there was a decrease in the percentage of germination as if moved to seed maturation.

Table 2 - Mass of a thousand seeds (MTS), first count of germination (FCG), percentage of germination (G), percentage of abnormal seedlings (AB), germination speed index (GSI), average time of germination (ATG), average speed of germination (ASG) of seed at different maturation stages.

Maturation stage	MTS	FCG	G	AB	GSI	ATG	ASG
	G	%	%	%	un	days	$days^{-1}$
5 YR 6/8	45.16 a	3.00 a	46.00 ab	10.00 a	0.414 b	17.219 a	0.058 a
5 YR 4/6	38.14 b	6.00 a	57.00 a	8.00 a	0.716 a	17.048 a	0.059 a
2.5 YR 3/4	33.12 c	2.00 a	34.00 b	7.00 a	0.367 b	16.716 a	0.060 a

Averages followed by the same letter did not differ statistically among themselves by Duncan test at 5% probability.

As can be seen in Table 3, there was no significant effect among the treatments for the percentage of abnormal seedlings. In the first count of germination, the seeds of stage 2 of maturation were superior to the other, with an average of 19%. The highest means of G% were observed for the treatment 5 YR 4/6 (stage 2), however, this did not differ statistically from the maturity stage 1, with medium, respectively, 72.0% and 59.0%.

The higher mean germination speed index and average speed of germination were checked for the treatments 5 YR 4/6 and 2.5 YR 3/4, consequently, for these same maturation stages were observed lower average times of germination.

Table 3- First count of germination (FCG), percentage of germination (G), percentage of abnormal seedlings (AS), germination speed index (GSI), average time of germination (ATG), average speed of germination (ASG) of seed at different stages of maturation, subjected to accelerated aging.

Maturation stage	FCG	G	AS	GSI	ATG	ASG
	%	%	%	un	days	$days^{-1}$
5 YR 6/8	1.00 b	59.00 ab	9.00 a	0.373 b	17.432 a	0.057 b
5 YR 4/6	19.00 a	72.00 a	3.00 a	0.829 a	15.427 b	0.065 a
2.5 YR 3/4	6.00 b	47.00 b	7.00 a	0.623 ab	16.253 b	0.061 a

Averages followed by the same letter did not differ statistically among themselves by Duncan test at 5% probability.

The accelerated aging test showed to be effective for classification of seed vigor of *Cedrela fissilis* in different maturation stages. [5] reported that the period of 48 hours of aging, at a temperature of 41°C was efficient to stratify seed in different vigor.

As shown in Table 4, the length of the hypocotyl at maturity stage 2 (5 YR 4/6) was higher than in the stage 3 (2.5 YR 3/4), however did not differ from the treatment 1 (5 YR 6/8), noting that in the early stages of maturation the hypocotyl has developed well than in the last stage. Coinciding with the result of dry mass of the hypocotyl. [16] observed results as worker with *Tabebuia chrysotricha*, where a higher relation of the aerial part was obtained in the seedlings of fruits collected in the initial stage of maturation.

As to the length of root, the stage 5 YR 6/8 (stage 1) presented higher average when compared to other treatments. These results coincide with those who [17] obtained by studying the different maturation stages in fruits of *Eugenia pyriformis*, where they found the higher mean root length in the initial stage of maturation.

For the diameter of the hypocotyl, no significant difference was found for the treatments, with average ranging from 1.07 mm to 1.14 mm, showing that this parameter was not influenced by maturation.

As for the number of leaflets, the stage 1 (3.68) showed higher mean in relation to stage 3 (2.99), but did not differ statistically from stage 2 (3.25), so that at the beginning of maturation the number of leaflets was higher.

The maturation stages 1 and 2 were higher than the level 3 to crush of dry matter of the hypocotyl. And the same was observed in dry matter of root, but the stage 2 did not differ from 3.

[18] studying different maturation stages with fruits of *Jatropha curcas* found different results for dry weight of seedlings, in the largest quantities have been conferred on seeds of fruits in more advanced stage of maturation.

Table 4- Length of hypocotyl (LH), root length (RL), diameter at the base of the hypocotyl (DH), number of leaflets (NF), dry mass of hypocotyl (DMH) and dry matter of root (DMR) of seedlings of cedar obtained from seeds at different maturation stages.

Maturation stage	LH	RL	DH	NF	DMH	DMR
	cm	cm	mm	un	g	g
5 YR 6/8	5.88 ab	3.32 a	1.07 a	3.68 a	0.200 a	0.027 a
5 YR 4/6	6.79 a	2.25 b	1.14 a	3.25 ab	0.196 a	0.019 ab
2.5 YR 3/4	5.24 b	1.97 b	1.07 a	2.99 b	0.100 b	0.007 b

Averages followed by the same letter did not differ statistically among themselves by Duncan test at 5% probability.

The maturation stages of seed resulted in significant effects in the mass of a thousand seeds, germination percentage and germination speed index of same. The accelerated aging test was efficient for classification of levels of seed vigor of *C. fissilis* in different maturation stages. The stage of maturation is bearing on the quality of seedlings. In most parameters observed the stages 1 and 2 showed better results.

IV. Conclusion

The maturation stages of seed resulted in significant effects in the mass of a thousand seeds, germination percentage and germination speed index of same.

The accelerated aging test was efficient for classification of levels of seed vigor of *C. fissilis* in different maturation stages.

The stage of maturation is bearing on the quality of seedlings.

In the germinative and vigor parameters it was observed that stages 1 and 2 presented better results.

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