

Original Research Article

Physiological potential of seeds of *Dovyalis abyssinica* under different light quality

ABSTRACT

Aims: This study aimed to evaluate the effects of different light spectra (quality of light) on the germination and force of seeds of *Dovyalis Abyssinica*.

Study design: The treatments were arranged in a completely randomized experimental design

Place and Duration of Study: The experiment was conducted in the Laboratory of Seed

Technology, belonging to the State University of Western Paraná (UNIOESTE), Marechal Cândido Rondon - Paraná, Brazil, in the period from May to June 2017.

Methodology: The seeds were subjected to the following light regimes: white, blue, yellow and red, and the absence of light. The absence of light was obtained by the use of aluminum foil involving the gerbox boxes. The lights red, yellow and blue were obtained with cellophane, involving the gerbox boxes, and for the white light were used gerboxes without coverage. The effects of the treatments were evaluated by means of the following tests: germination, germination speed index and seedling performance. The results were tested for normality by the lilliefors test and subjected to analysis of variance (F test) and the averages means were compared by the Tukey test at 0.05% probability.

Results: The highest germination percentage was observed in seeds subjected to the yellow light, and in the absence of light, with averages means, corresponding to 70% and 61%, respectively, however, did not differ statistically from seeds subjected to the red and white lights. These results show that the absence of light which the seeds and seedlings of *D.ovyalis Abyssinica* were submitted, stimulated a super stretching.

Conclusion: In general appearance the results observed in this study show that, despite the seeds of *D.ovyalis Abyssinica* present themselves as indifferent to light for germination, it was found that the quality of light to which the seeds and seedlings are subjected has great influence in its development, with direct effects on its physiological potential. Therefore, it is suggested that the lights of red and yellow provided better environment the seeds of the species studied, once these propitiated medium high index of germination speed and lower average mean germination time, with special attention to the quality of red light that favored the higher performance of seedlings.

Key words: light spectrum, small fruit, germination, force.

1. INTRODUCTION

Dovyalis Abyssinica is a fruit species belonging to the Salicaceae family (Flacourtiaceae), originating from Africa. The fruit has a spherical shape, with juicy pulp and naturally acidic, desired characteristic for the manufacturing of jams, jellies and fruit juices. It has a thin skin with the orange color, red, covered by a soft layer to produce a texture quite pleasant to the touch. The small seeds and easily removable result in high yield in pulp and confirm their suitability for processing [1]. The weight of the seeds depends on the provenance and the weather conditions during the ripening period [2].

The germination of seeds is influenced by internal and external factors. The internal ones are the intrinsic ones factors of the seed and the external ones are related to the environmental conditions, like temperature, water, oxygen and the quality of light [3].

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The seed response to light is associated with phytochrome, the receptor pigment responsible for the capture of light signals that may or may not trigger the germination of the seeds, but the action of this pigment depends on the type of radiation, in other words, the quality of incident light [4].

Several authors have observed that the direct influence of the quality of light on the potential of germination and force of seeds, as seeds of *Melocactus conoideus* [5], *Phyllanthus tenellus* [6], and *Jatropha curcas* L. [7], *Euphorbia hirta* and *Euphorbia hyssopifolia*, *Euphorbia heterophylla* [8].

Starting from the principle that each plant species has a differential response to light, and that the quality of light that reaches the seeds and they absorb entail distinct effects, on physiological and potential on germination potential and fisiológico, this study aimed to evaluate the effects of different light spectra (quality of light) on the germination and force of seeds of *Dovyalis abyssinica*.

2. MATERIAL AND METHODS

The experiment was conducted in the Laboratory of Seed Technology, belonging to the State University of Western Paraná (UNIOESTE), Marechal Cândido Rondon — Parana, Brazil.

To obtain the seeds, they were harvested from fruits in complete maturation of plants of *Dovyalis abyssinica* belonging to the Active Germplasm Bank of UNIOESTE. The fruits were manually stripped with rubbing in sand and then washed in running water.

The seeds remained 48 hours drying at ambient room temperature in the shade, and later held the determination of the degree of humidity degree was determined, with 4 repetitions of 2 grams, by the oven method at 105 °C for 24 hours [9].

The seeds were randomly divided into 4 repetitions of 25 each one, were placed in gerbox type boxes, in vermiculite and kept in chambers of germination type BOD, with a photoperiod of 12 hours of light at a constant temperature of 25 °C.

The seeds were subjected to the following light regimes: white, blue, yellow and red, and the absence of light. The absence of light was obtained by the use of aluminum foil involving the gerbox boxes. The lights red, yellow and blue were obtained with cellophane, involving the gerbox boxes, and for the white light were used gerboxes without coverage.

The effects of light quality were evaluated by means of the following tests:

Germination: conducted in accordance with the Rules for Seed Analysis [9]. At the end of the germination test were calculated, the percentage of germination (I), average time (II) and average speed of germination (III), in accordance with the formulas proposed by Labouriau [10]. Germinated seeds were considered to be those that presented hypocotyl and radicle developed.

$$G (\%) = (N/A) \times 100$$

Where: G - this is the percentage of germination; N is the number of germinated seeds; and A - this is the total number of seeds germinated.

$$MGT = \frac{\sum nr \cdot ti}{\sum nt_{total}} \text{ (days)} \quad ASG = \frac{1}{MGT} \text{ (seeds/day)}$$

Where: MGT - refers to the average time of germination in days; nt - is the number of germinated seeds in a time interval; ti - is the time interval; ntotal is the total number of germinated seeds; ASG - is the average speed of germination.

The GSI calculations were performed by Maguire [13]:

$$GSI = G_1 + \frac{G_2}{2} + \dots + \frac{G_n}{n}$$

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In that: GSI= germination speed index; G= number of germinated seeds; N= number of days from sowing.

Performance of seedlings: Assessed by measurement of length of hypocotyl and radicle, conducted with the aid of graduated ruler and the results were expressed in cm^{-1} and the diameter at the base of the hypocotyl in mm^{-1} using a digital pachymetercaliper. This evaluation was performed at the end of the experiment.

The treatments were arranged in a completely randomized experimental design with four replications. The results were tested for normality by the Lilliefors test and subjected to analysis of variance (F test) and the averages means were compared by the Tukey test at 0.05% probability.

3 RESULTS AND DISCUSSION.

The Seeds of *D.ovyalis abyssinica* on timeat the beginning of the experiment of installation of the test presented average mean water content of 39.4%. Oliveira,[12] working with seeds of the same species observed moisture content of seeds at around 40.0%, close to that observed in this study.

There was a significant effect ($P_0 \leq 0.05$) for percentage of germination (G%), germination speed index (GSI), average mean germination time (MGT) and average mean speed of germination (ASG) *Dovyalis Abyssinica* seeds submitted to different qualities of light (Table 1).

With respect to their germination response to light stimulus, the seeds are classified into: positive photoblastic, are the ones who need light to germinate; photoblastic negative, that only germinate in the absence of light; and indifferent to light [13]. *D.ovyalis Aabyssinica* seeds germinated in the presence and in the absence of light, therefore, in relation to this characteristic, these can be spoken as indifferent to light.

The highest germination percentage was observed in seeds subjected to the yellow light, and in the absence of light, with averagesmeans, corresponding to 70% and 61%, respectively, however, did not differ statistically ($p > 0.05$) from seeds subjected to the red and white lights. Galindo et al., [14] found, for seeds of *Crataeva tapia*, that at a temperature of 25 ° C, higher percentages of germination occurred under red light, and in the absence of light.

For GSI, the highest averages were found in treatments with yellow and white lights, however, did not differ statistically ($p > 0.05$) from seeds germinated in white light. Parreira et al., [15] found that the different wavelengths of light tested significantly affected the germination percentage and the GSI of *Spermacoce latifolia*. As for the MGT, the to higher means was were observed for the seeds subjected to the absence of light, simultaneously, we it was observed a smaller lower average mean time to germinate in seeds tested evaluated in the qualities of red and yellow lights being statistically ($p > 0.05$) similar to that germinated in yellow light. As a result of the greatest time of germination, the seeds subjected to the absence of light showed lower ASG, being statistically ($p > 0.05$) to those germinated in red and blue lights.

Table 1- Percentage of germination (G%), germination speed index (GSI), average mean germination time (MGT) and average mean speed of germination (ASG) of *Dovyalis Aabyssinica* seeds submitted to different qualities of light qualities.

Light quality	G (%)	GSI	MGT (days)	ASG (day^{-1})
White	50.00 ab	4.00 ab	5.03 b	0.22 a
Azul	33.00 b	1.55 c	6.66 b	0.16 ab
Yellow	70.00 a	4.56 a	4.76 bc	0.22 a
Red	45.00 ab	2.64 b	3.86 c	0.15 ab
Aabsence of light	61.00 a	1.31 c	11.94 a	0.08 b
C. V. (%)	17.71	11.55	14.75	16.48

Medium Means followed by the same letter, in the columns, do not differ by Tukey test ($P_0 \leq 0.05$). C. V. = Coefficient of variation

In Table 2, it is observed that the length of hypocotyl was greater in seedlings that have remained in the dark (5.85 cm) and the shortest length was in plants kept under white light and yellow lights (1.42 and 2.24 cm, respectively). These results show that the absence of light which where the seeds and seedlings of *D.ovyalis Aabyssinica*

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were ~~submitted~~subjected, stimulated a ~~super~~ bigger stretching. ~~Second~~ According to Kerbauy [16], the hypocotyl and coleoptile elongation is fast in the dark and typically inhibited by light, as observed in the present work.

~~Second~~ Kerbauy [16], indicated the seedlings grown in the dark are said to super elongated, presenting usually stem very elongated, absence of chlorophyll, leaves or cotyledons not expanded, in the present study, seedlings ~~submitted~~ subjected to dark had a more yellowish coloration.

As to the root length was observed highest averages means in seedlings subjected to red light, however, this did not differ between the averages means presented by seedlings kept in blue light, as well as in the absence of light. The largest mean diameter at the base of the hypocotyl were observed for the qualities of light, red, blue, and absence of light, statistically ($p > 0.05$) similar between a,omg themselves (Table 2).

Table 2. Length of hypocotyl (CH), radicle length (CR) and diameter at the base of the hypocotyl (DH), of seedlings of *Dovyalis Abyssinica*, under different qualities of light qualitoes.

Light quality	LH (cm ⁻¹)	LR (cm ⁻¹)	DH (mm ⁻¹)
White	1.42 c	2.33 c	0.41 b
Yellow	2.24 c	3.63 bc	0.38 b
Red	3.89 b	5.82 a	0.76 a
Azul	4.00 b	5.14 ab	0.83 a
The absence of light	5.85 a	4.42 ab	0.79 a
CV%	15.01	114.166	12.16

Medium Means followed by the same letter, in the columns, do not differ by Tukey test ($P_0 \leq 0.05$).
C. V. = Coefficient of variation

In this research it was verified that in the absence of light the seeds demanded greater average mean germination time, and had a lower average mean speed of germination. This same luminous condition provided the very elongation of the seedlings.

4. CONCLUSÃO CONCLUSION

In general, appearance the results observed in this study show that, despite the seeds of *Dovyalis D. AAbyssinica* present themselves as were indifferent to light for germination, however it was found that the light quality of light to which the seeds and seedlings are subjected has great influence in its development, with direct effects on its physiological potential.

Therefore, it is suggested that the lights of red and yellow provided better environment to the seeds of *D. Abyssinica* the species studied, once these propitiated medium to high index of germination speed and lower average mean germination time, with special attention to the quality of red light that favored the higher performance of seedlings.

REFERENCES

1. Silva J A A, Grizotto R K, Miguel F B, Barbararo I M. Physico-chemical characterization of fruits of doviális clones (*Dovyalis abyssinica* Warb). Brazilian Journal of Fruit Crops. 2011; special (1): 466-472.
2. Kiamba J K, Schmidt L H, Mbora A. *Dovyalis abyssinica* (A. Rich) Warb. Seed Lleaflet. 2009;(144): 01-03.
3. Carvalho N M, Nakagawa J. Seeds: science, technology and production. 5th ed. Jaboticabal: Funep; 2012.

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4. Vázquez_Yanes C, Orozco_Segovia A. Ecological significance of light controlled seed germination in two contrasting tropical habitats. *Oecologia*. 1990; 83(2): 171-175.
5. Rebouças A C M N, Santos D L. Influence of Photoperiod and Light Qquality on Ggermination of Sseeds of Melocactus conoideus (Cactaceae). *Brazilian Journal of Biosciences*. 2007; 5 (2): 900-902.
6. Victório C P, Lage C L S. Effect of light quality on germination and initial in vitro development of Phyllanthus tenellus. *Journal of Agronomic Science*. 2009; 40 (3): 400-405.
7. Silva F J, Hisatugo E Y, Souza J P. Effect of light on germination and development of Jatropha curcas L. (Jatropha curcas L.) seedlings from different sources. *Hoehnea*. 2016; 43 (2): 195-202. Doi: 10.1590 / 2236-8906-80 / 2015.
8. Germination of three Euphorbiaceae influenced by light and straw levels. [2] Ferreira D T R G, Silva V M, Silva I C, Araujo Neto J C, Souza R C, Ferreira V M. Germination of three Euphorbiaceae influenced by light and straw levels. *Revista Agro @ mbiente On-line*. 2017; 11 (3): 215-222.
9. BRAZIL. Ministry of Agriculture Livestock and Supply. Rules for seed analysis. Brasília: Map / ACS; 2009.
10. Labouriau, L.G. The germination of the seeds. 1st ed. Washington: General Secretariat of the Organization of American States; 1983.
11. Maguire, J.D. Speed of germination aid in selection and evaluation for seeding emergence and vigor. *Crop Science*. 1962; 2(2): 176-177.
12. Influence of temperature on seed germination of dovalis (D. abyssinica Warb. X D. hebecarpa Warb)] [Article in Portuguese] Oliveira I V M, Costa R S, Andrade R, LUCENA Calvacante I H, Martins Caatinga Magazine. 2007; 20 (1): 71-74.
13. Orozco-Segovia A, Vazquez-Yanes C. The senses of plants: The sensitivity of seeds to light. *Science*. 1992; 43: 399-411.
14. Galindo E A, Alves E U, Silva K B, Barrozo L M, Moura, S S S. Germination and vigor of seeds of Crataeva tapia at different temperatures and light regimes. *Agronomic Science*. 2012; 43 (1): 138-145.
15. Parreira M C, Cardozo N P, Giancotti P R F, Alves P L. Overcoming dormancy and influence of environmental factors on seed germination of Spermacoce latifolia. *Brazilian Journal of Agricultural Sciences*. 2011; 6 (3): 427-431.

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16. KERBAUY G. B. Plant [p](#)Physiology. 2nd ed. Rio de Janeiro: Guanabara Publishing House Koogan S.A; 2008.