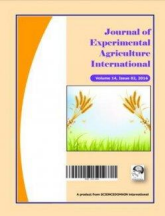

Journal of Experimental Agriculture International

26(1): 1-5, 2018; Article no.JEAI.43853
ISSN: 2457-0591
(Past name: American Journal of Experimental Agriculture, Past ISSN: 2231-0606)

Physiological Potential of Seeds of *Dovyalis abyssinica* Warb under Different Light Quality

Patrícia Gibbert[1], Maria Soraia Fortado Vera Cruz[1], Ana Carolina Pinguelli Ristau[1*], Fabíola Villa[1] and Marlene de Matos Malavasi[1]

[1]State University of Western Paraná, Marechal Cândido Rondon, Paraná, Brazil.

Authors' contributions

This work was carried out in collaboration between all authors. Author PG designed the study, performed the statistical analysis and wrote the protocol. Authors MSFVC and ACPR managed the analyses of the study, wrote the first draft of the manuscript and reviewed the manuscript. Authors FV and MMM managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JEAI/2018/43853
Editor(s):
(1) Dr. Bishun Deo Prasad, Assistant Professor, Department of Molecular Biology & Genetic Engineering, Bihar Agriculture College, Sabour, Bihar Agricultural University, Bihar, India.
Reviewers:
(1) Jesús Rafael Méndez-Natera, Universidad de Oriente, Venezuela.
(2) Schirley Costalonga, Universidade Federal do Espírito Santo, Brazil.
(3) M. Serhat Odabas, Ondokuzmayis University, Turkey.
Complete Peer review History: http://www.sciencedomain.org/review-history/26289

Short Communication

Received 16 June 2018
Accepted 05 September 2018
Published 20 September 2018

ABSTRACT

Aims: This study aimed to evaluate the effects of different light spectra (quality of light) on the germination and vigour of seeds of *Dovyalis abyssinica* Warb.
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. Absence of light was obtained by the use of aluminium foil involving the gerbox type plastic boxes. The lights red, yellow and blue were obtained with cellophane, involving the gerbox boxes, and for the white light were used gerbox without coverage. The effects of treatments were evaluated using 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 means were compared by the Tukey test at 0.05 probability.
Results: The germination percentage was similar ($p > 0.05$) among the absence of light, and

**Corresponding author: E-mail: ana_ristau@hotmail.com;*

yellow, red and white lights. The results shows that the absence of light which the seeds and seedlings of *D. abyssinica* were submitted, stimulated a super stretching.
Conclusion: In general appearance, the results observed in this study show that despite the seeds of *D. abyssinica* present themselves as indifferent to light for germination; it was revealed that the quality of light to which the seeds and seedlings are subjected has significant influence in its development.

Keywords: Light spectrum; small fruit; germination; vigour.

1. INTRODUCTION

Dovyalis abyssinica Warb is a fruit species belonging to the Salicaceae family (Flacourtiaceae), originating from África. 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 a colouration ranging from orange, red or purple, covered by a soft layer to produce texture very 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 weather conditions during the ripening period [2].

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

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 contrast, the quality of incident light [4].

Several authors have observed that the direct influence of quality of light on the potential of germination and vigour of seeds, such as *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 quality of light that reaches the seeds and they absorb entail distinct effects on physiological and potential germination, this study aimed to evaluate the effects of different light spectra (quality of light) on the germination and vigour of seeds of *Dovyalis abyssinica*.

2. MATERIALS AND METHODS

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

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

The seeds remained 48 hours drying at room temperature in the shade (25 ±3°C), and later the humidity was determined, with 4 repetitions of 2 grams, by using 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 aluminium foil involving the gerbox type boxes. The lights red, yellow and blue were obtained with cellophane, involving the gerbox type boxes, and for the white light were used gerbox type boxes without coverage.

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

Germination: It was determined by 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), by the formulas

proposed by Labouriau [10]. Germinated seeds were considered to be those that presented developed hypocotyl and radicle.

G (%) = (N/A) x 100

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

$$\mathrm{MGT} = \frac{\sum \mathrm{nt} \,.\, \mathrm{ti}}{\sum \mathrm{ntotal}} \ (\mathrm{days}) \qquad \mathrm{ASG} = \frac{1}{\mathrm{MGT}} \ (\mathrm{seeds/day})$$

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 [11]:

$$\mathrm{GSI} = \frac{\mathrm{G1}}{\mathrm{N1}} + \frac{\mathrm{G2}}{\mathrm{N2}} + \cdots + \frac{\mathrm{Gn}}{Nn}$$

In that: GSI - refers to the germination speed index; G - number of germinated seeds; N - number of days from sowing.

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

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

3. RESULTS AND DISCUSSION

The seeds of *D. abyssinica* at the beginning of the experiment presented mean water content of 39.4%. Oliveira [12] working with seeds of the same species observed moisture content of seeds around 40.0%, near to that found in this study.

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

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

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

For GSI, the highest averages were resulted in treatments with yellow light, however, it differs 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, higher means were observed for the seeds subjected to the absence of light, simultaneously, it was observed a lower mean time to germinate in seeds evaluated in red light being statistically ($p > 0.05$) similar in compared to sprouted in yellow light. As a result of the greatest time of germination, seeds subjected to the absence of light showed lower ASG, being statistically ($p > 0.05$) to those germinated in red and blue lights.

In Table 2, it is observed that the length of hypocotyl was greater in seedlings remained in the dark (5.85 cm) and the shortest length was in plants kept under white and yellow lights (1.42 and 2.24 cm, respectively). These results show that the absence of light where the seeds and seedlings of *D. abyssinica* were subjected, stimulated a bigger stretching. According to Kerbauy [16], the hypocotyl and coleoptile elongation is fast in dark condition and typically inhibited by light, as observed in the present work.

Kerbauy [16] reported that the seedlings grown in the dark are found to be super elongated,

Table 1. Percentage of germination (G%), germination speed index (GSI), mean germination time (MGT) and mean speed of germination (ASG) of *Dovyalis abyssinica seeds* submitted to different 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
Absence of light	61.00 a	1.31 c	11.94 a	0.08 b
C. V. (%)	17.71	11.55	14.75	16.48

Means followed by the same letter, in the columns, do not differ by Tukey test (p ≤ 0.05). C. V. = Coefficient of variation

presenting very elongated stem, the absence of chlorophyll, and leaves or cotyledons did not expand. In the present study, seedlings subjected to dark had a more yellowish colouration.

The root length was observed to record the highest means in seedlings subjected to red light; However, this did not differ between the 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 was observed for the qualities of light, red, blue, and absence of light, statistically ($p > 0.05$) similar among them (Table 2).

Table 2. Length of hypocotyl (LH), radicle length (RL) and diameter at the base of the hypocotyl (DH) of seedlings of *Dovyalis abyssinica,* under different light qualities

Light quality	LH (cm)	LR (cm)	DH (mm)
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
Absence of light	5.85 a	4.42 ab	0.79 a
C. V. (%)	15.01	114.166	12.16

Means followed by the same letter, in the columns, do not differ by Tukey test (p ≤ 0.05). C. V. = Coefficient of variation

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

4. CONCLUSION

In general, seeds of *D. abyssinica* were indifferent to light for germination; however, it was found that the light quality to which the seeds and seedlings are subjected, has significant influence in its development.

Therefore, it is suggested that red and yellow lights provided a better environment to *D. abyssinica* seeds, once these propitiated medium to high index of germination speed and lower mean germination time, in reference to the quality of red light that favoured the higher performance of seedlings.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Silva JAA, Grizotto RK, Miguel FB, Barbararo IM. Physico-chemical characterization of fruits of doviális clones (*Dovyalis abyssinica* Warb). Brazilian Journal of Fruit Crops. 2011;(Special 1): 466-472.
2. Kiamba JK, Schmidt LH, Mbora A. *Dovyalis abyssinica* (A. Rich) Warb. Seed leaflet. 2009;144:01-03.
3. Carvalho NM, Nakagawa J. Seeds: Science, technology and production. 5th ed. Jaboticabal: Funep; 2012.
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 ACMN, Santos DL. Influence of photoperiod and light quality on germination of seeds of *Melocactus conoideus* (Cactaceae). Brazilian Journal of Biosciences. 2007;5(2):900-902.
6. Victório CP, Lage CLS. 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 FJ, Hisatugo EY, Souza JP. Effect of light on germination and development of *Jatropha curcas* L. seedlings from different sources. Hoehnea. 2016;43(2):195-202. DOI: 10.1590 / 2236-8906-80 / 2015
8. Ferreira DTRG, Silva VM, Silva IC, Araujo Neto JC, Souza RC, Ferreira VM. 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 LG. The germination of the seeds. 1st ed. Washington: General Secretariat of the Organization of American States; 1983.
11. Maguire JD. 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 dovialis (*D. abyssinica* Warb. X*D. hebecarpa* Warb)] [Article in Portuguese] Oliveira IVM, Costa RS, Andrade R, LUCENA Calvacante IH. 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 EA, Alves EU, Silva KB, Barrozo LM, Moura SSS. Germination and vigor of seeds of *Crataeva tapia* at different temperatures and light regimes. Agronomic Science. 2012;43(1):138-145.
15. Parreira MC, Cardozo NP, Giancotti PRF, Alves PL. Overcoming dormancy and influence of environmental factors on seed germination of *Spermacoce latifolia*. Brazilian Journal of Agricultural Sciences. 2011;6(3):427-431.
16. Kerbauy GB. Plant physiology. 2nd ed. Rio de Janeiro: Guanabara publishing house. Koogan SA; 2008.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/26289