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Enhancing Germination Efficiency of Dragon Fruit (*Hylocereus spp.*) Seeds under Varied Climatic Conditions in East Nimar, Madhya Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The current study sought to identify optimal pre-treatment approaches for increasing seed germination percentage and vigor. Regardless of the therapies. The experiment was set up in randomized block design (RBD), with three replications. The nursery experiment was carried out in 2024 at the School of Agriculture Science, Dr. C.V. Raman University in Khandwa, Madhya Pradesh. Dragon fruit seeds from seven treatments were pretreated with various pretreatments, viz. T_1 Darkness + water soaking 12 hours; T_2 Darkness + water soaking 24 hours; T_3 Continuous light (24 hours) + water soaking 12 hours. T_4 Continuous light (24h) + water soaking for 24 hours, T_5 Alternating light (12h light/12h dark) + water soaking for 12 hours T_6 alternating light (12h light/12h dark) + water soaking for 24 hours, T_7 Control (without pretreatment) to examine the

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impacts on germination %, germination value, mean germination time, and seedling vigour index. Seeds pre-treated with T-6 Alternating light (12h light/12h dark) + water soaking 24 hours had the highest average germination percentage (94.66%), while control had the lowest germination percentage (78.66%) when compared to other pre-treatments among all treatments, and the highest average mean germination value (9.57), while T_7 Control had the lowest mean germination value (6.71). Seeds were pre-treated with T_7 control recorded average highest mean germination time 21.21 days, while T_6 Alternating light (12h light/12h dark) + water soaking 24 hours showed lowest mean germination time as compared to other pre-treatments among all treatments, When compared to other pre-treatments, T_7 control had the lowest mean seedling vigor index (694.09) across all treatments.

Keywords: Dragon fruit; germination percentage; germination value; mean germination time; seedling vigor index.

1. INTRODUCTION

The climbing cactus known as dragon fruit (*Hylocereus undatus*) is an epiphytic perennial (ElObeidy, 2006), Pink Dragon Fruit is a captivating and nutritious fruit, boasts an enchanting pink hue and scales-like exterior. Native to the lush regions of Central and South America, this vibrant fruit has been cherished for centuries. Dragon fruit is a climbing cactus species, As a member of the Cactaceae family or Pitaya family, it's also known by its alternate names: Pitahaya and Strawberry Pear. The fruit has three varieties: Pink Pitaya (white flesh with pink skin: *Selenicereus undatus*), Red Pitaya (red flesh with red skin: *Selenicereus costaricensis*), and Yellow Pitaya (white flesh with yellow skin: *Selenicereus megalanthus*).

Seed germination has other utility also. Speed of germination has long been used as indicator of vigour (AOSA, 1976). Seed vigour is an important factor determining seed quality in forest trees (Vlase & Voinesou, 1972). Seed vigour is one of the most important parameter in determining seed quality and it is the sum total of those properties of seed which determine the potential level of performance and activity of a non-dormant seed of a seed lot during germination and seedling emergence.

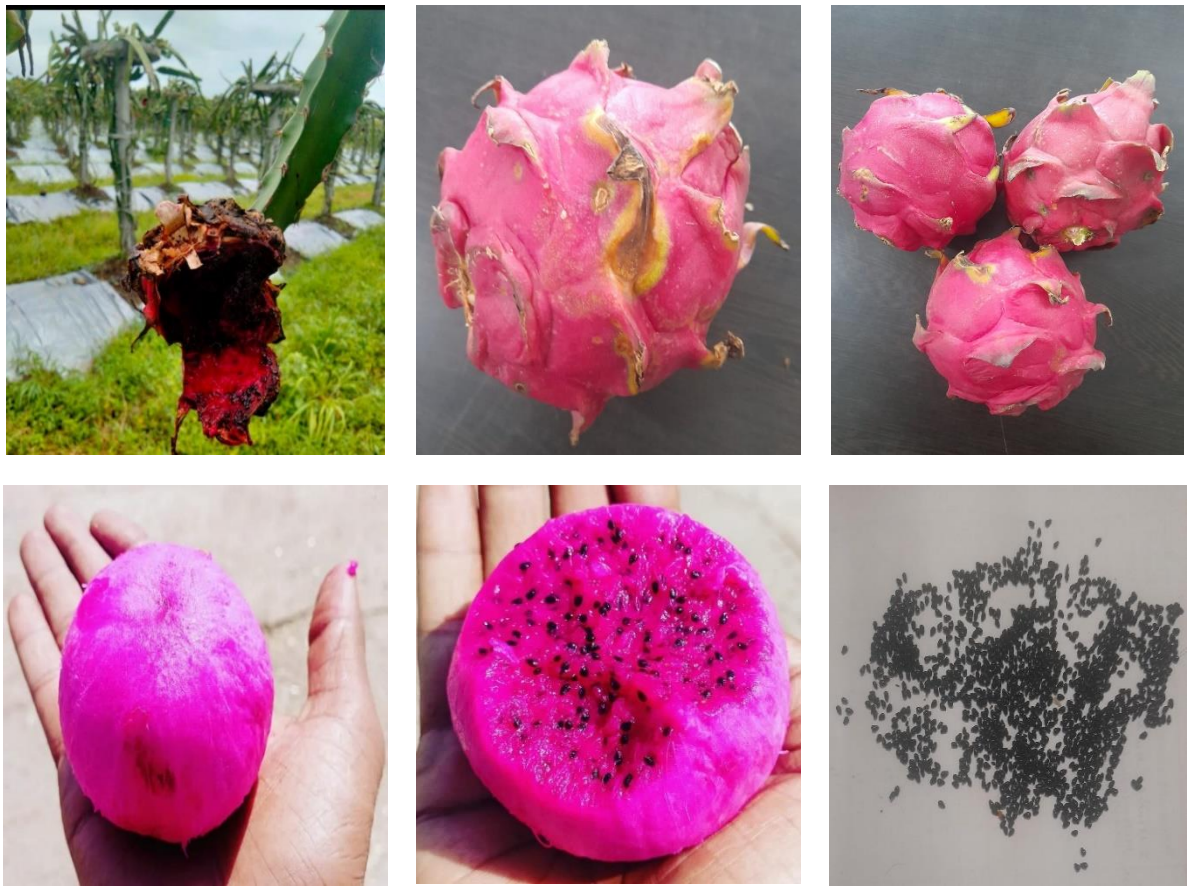
Seed dormancy is a physiological state that prevents germination under favorable conditions. Dragon fruit seed dormancy is a physiological phenomenon that limits germination under favorable conditions while determining the range of conditions that allow for germination. The intrinsic molecular processes governing dormancy may include an embryo or a coat component that interacts to determine the degree of 'whole-seed' dormancy (Hilhorst, 1995).

Dragon fruit is not only beautiful, but it is also high in nutritional content and bioactive components, including potent natural antioxidants (Huang et al., 2021). Several studies show that dragon fruit has therapeutic potential for type 2 diabetes (Suryono, 2006). Dragon fruit includes a high concentration of vitamin "C," which is important for boosting the immune system and general health. Furthermore, dragon fruit is high in fiber, which helps to improve gut health and prevent constipation (Ghee & Voon, 2021). Dragon fruit also includes betalains and carotenoids, which, in addition to giving the fruit its brilliant color, are powerful antioxidants. These molecules help neutralize damaging free radicals in the body, lowering the risk of chronic illnesses and improving general cellular health (Hossain et al., 2021). Dragon fruit is also high in iron, magnesium, and potassium, which are all necessary elements. which are essential for a variety of biological activities, including muscular contraction, neuronal transmission, and blood pressure control (Luu et al., 2021). Fruit is not only a visual delight but also packed with nutrients: Rich in vitamins C and B2, Good source of potassium, iron, and magnesium Antioxidant properties and low calorie count.

2. MATERIALS AND METHODS

2.1 Study Area

The enhancing germination efficiency of Dragon fruit (*Hylocereus* spp.) Seeds under Varied Climatic Conditions in East Nimar, Madhya Pradesh, experiment on Dragon fruit was conducted in the nursery of Dr. C.V. Raman University Khandwa M.P. The study location comes under tropical and subtropical climate zone and is located at 21°50'N, latitude and 76°13'E longitude and the maximum and minimum height above mean sea level is 905.56 m and 180.00 m respectively.



Picture 1. Visual appearance of dragon fruits

2.2 Experimental Details

Seeds were taken from a fresh dragon fruit with pink skin and pink meat collected by farmers. The fruit was then chopped into little pieces and the seeds taken from them. We treated the seeds under varied environments, as shown, T_1Darkness+ water soaking 12 hours, T_2 Darkness + water soaking 24 hours, T_3 Continuous light (24h) + water soaking 12 hours, T_4 Continuous light (24h) + water soaking 24 hours, T_5 Alternating light (12h light/12h dark) + water soaking 12 hours, T_6 Alternating light (12h light/12h dark) + water soaking 24 hours, T_7 Control.

Seeds were planted in three replications of plastic bags measuring 30x20 cm each. Before sowing, polybags were filled with a 1:2:1 potting mixture consisting of soil, FYM, and sand. The seeds were then sown in plastic bags. Seed germination was observed daily for at least 28 days, or until no further germination occurred. Weeding, cleaning, and watering the polybags were done manually as needed throughout the trial, which might last up to a year. A was considered germinated when the plume rose one millimeter above the soil surface. The poly bags were organized in an RBD sequence of three replications.

After each pre-treatment the seeds were sown in polybags for germination test in the nursery and the following parameters were recorded as given below:

Germination percent (GP): It was the percent of the sown seeds germinated at the completion of test period, i.e., 28 days after sowing (ISTA, 1999). It was calculated by the following formula:

$$\text{GP}\ (\%)\ = \frac{\text{Total number of seed germinated}}{\text{Total number of seeds sown}} \times 100$$

Germination value (GV): It is an index combining speed and completeness of seed germination. It was calculated as per the method given by Czabator (1962):

GV = PV x MDG

Where,

GV = Germination value
PV = Peak value of germination and
MDG = Mean daily germination

Mean germination time (MGT): The time taken to complete germination was determine as MGT in days according to Bonner (1983) and Dey (2012) as given in below:

$$\text{Mean Germination Time} = \frac{\Sigma\ (\text{Daily germination x Days})}{\text{Number of seed sown}}$$

Where, n = number of seed, which were germinated on day D, and D is number of days counted from the beginning of germination

Seedling vigor index (SVI): The seedlings vigour index was calculated as per the formula given by Abdul-Baki & Anderson, (1973). It reflex the health of the seedling produced.

SVI = Germination percentage (%) x Seedling length (cm)

3. RESULTS AND DISCUSSION

Data pertaining to the pre-treatment of seeds among seven treatments have been furnished in the Table 1 and Fig. 1. Seeds of among seven treatments of *Dragon fruits* were pretreated with different pre-treatments viz. T_1Darkness+ water soaking 12 hours, T_2 Darkness + water soaking 24 hours, T_3 Continuous light (24h) + water soaking 12 hours, T_4 Continuous light (24h) + water soaking 24 hours, T_5 Alternating light (12h light/12h dark) + water soaking 12 hours, T_6 Alternating light (12h light/12h dark) + water soaking 24 hours, T_7 Control (no pre-treatment) to observe their effects on germination percentage, germination value, mean germination time and seedling vigour index. Germination potential of all treatments differed significantly due to pre-treatments. Irrespective of treatments, the average germination was 84.33, 86.33, 84.33, 87.66, 86.66, 94.66 and 78.66, respectively when seeds were pre-treated with T_6 Alternating light (12h light/12h dark) + water soaking 24 hours recorded average highest germination percentage 94.66% while control showed lowest germination percentage 78.66 % as compared to other pre-treatments among all treatments.

The germination value of all treatments recorded significantly varied greatly owing to pre-treatments. Regardless of treatment, the average germination value was 7.24, 7.78, 8.25, 8.47, 7.58, 9.57, and 6.71, respectively. When seeds were pre-treated with T_6 Alternating light (12h light/12h dark) + water soaking 24 hours, the average highest mean germination value was 9.57, while T_7 Control had the lowest mean germination value of 6.71 when compared to other treatments. Table 1 and Fig. 1 show data on seed pre-treatment across seven treatments.

The mean germination time of all treatments recorded significantly varied substantially according to pre-treatments. The average mean germination time was 18.65, 18.48, 18.25, 18.44, 18.58, 15.92, and 21.21 days when seeds were pre-treated with T-7 control. T-6 Alternating light (12h light/12h dark) + water soaking 24 hours had the lowest mean germination time when compared to other pre-treatments. Table 1 and Fig. 1 show data on seed pre-treatment across seven treatments.

Picture 2. Juvenile phase of dragon fruits

Table 1. Effect of pre-treatments on seed germination percentage (GP), Germination Value Mean germination time (days) and Seedling vigour Index

Name of Treatment	Germination percentage (%)	Germination Value	Mean germination time (days)	Seedling vigour Index
T1 Darkness+ water soaking 12 hours	84.33	7.24	18.65	787.53
T-2 Darkness + water soaking 24 hours	86.33	7.78	18.48	911.82
T-3 Continuous light (24h) + water soaking 12 hours	84.33	8.25	18.25	931.55
T-4 Continuous light (24h) + water soaking 24 hours	87.66	8.47	18.44	676.06
T-5 Alternating light (12h light/12h dark) + water soaking 12 hours	86.66	7.58	18.58	760.61
T-6 Alternating light (12h light/12h dark) + water soaking 24 hours	94.66	9.57	15.92	1161.94
T-7 Control	78.66	6.71	21.21	694.09
Mean	**86.06**	**7.94**	**18.50**	**846.23**
CV (%)	**2.126**	**4.238**	**4.327**	**6.796**
S.Em (+)	**1.054**	**0.194**	**0.462**	**33.202**
SE(d)	**1.491**	**0.275**	**0.654**	**46.955**
CD (p=0.05)	**3.284**	**0.606**	**1.440**	**103.440**

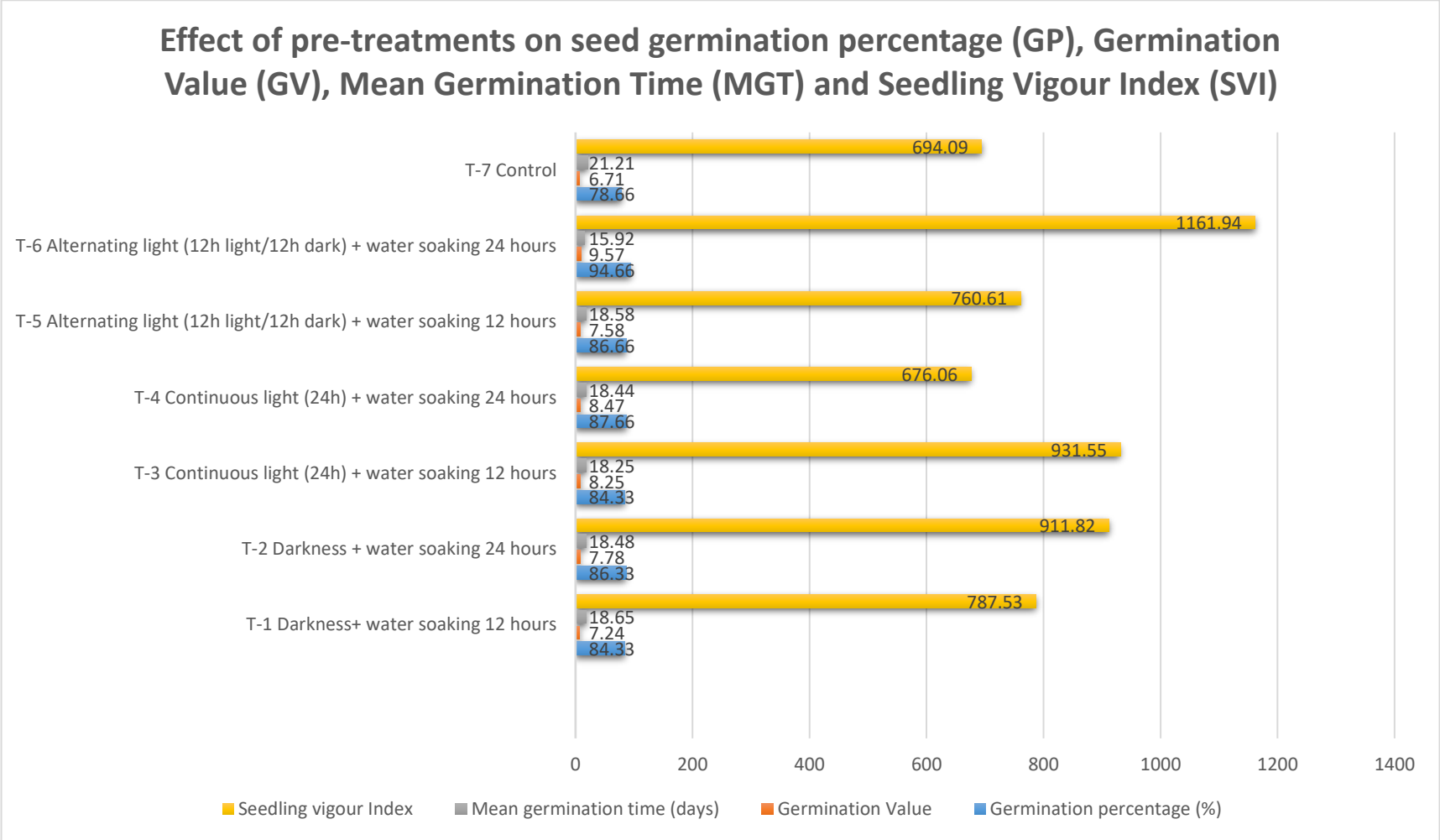


Fig. 1. Effect of pre-treatments on seed germination percentage (GP), Germination Value (GV), Mean Germination Time (MGT) and Seedling Vigour Index (SVI)

The seedling vigor index exhibited significant variations among treatments, indicating a substantial impact of pre-treatment methods. Specifically, the combination of alternating 12h light/dark cycles with 24h water soaking (T_6) recorded the highest seedling vigor index (1161.94), whereas the control treatment (T_7) displayed the lowest value (694.09). Mean germination times for each treatment are reported. Further details are provided in Table 1 and Fig. 1. The average seedling vigor Index was 787.53, 911.82, 931.55, 676.06, 760.61, 1161.94 and 694.09 respectively

Above this context, the present study was carried out to find perfect pre-treatment methods for enhancing germination percentage and vigour of the seeds. Irrespective of all treatments The results are well in line with the findings reported by Anagha, P., et al. (2023). Improving seed germination and seedling growth of dragon fruit (*Hylocereus undatus*). After maturity and collection, seeds are required to germinate to assess the proper growth and survival of seedlings.

4. CONCLUSION

An experimental study was conducted to determine the most effective pre-treatment method for enhancing germination percentage and vigor of dragon fruit seeds. The experiment, laid out in a randomized block design, evaluated seven pre-treatment combinations of light and water soaking. The results indicated that alternating 12h light/dark cycles with 24h water soaking significantly improved germination percentage, achieving an average of 94.66%."

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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