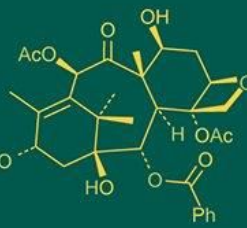
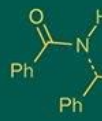
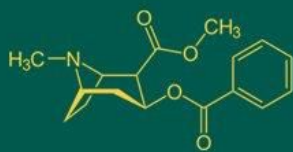


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Effect of Different Water Temperatures on the Germination of *Flemingia semialata* Seedlings

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Abstract

Seedling germination of *Flemingia semialata*, a leguminous species commonly used in agroforestry systems, is influenced by various environmental factors, including water temperature. This study investigates the impact of different water temperatures on seedling growth of *F. semialata*. Seeds were exposed to five water temperature treatments over three different durations (5 minutes, 10 minutes, and 15 minutes) at the following temperatures: 20 °C, 40 °C, 60 °C, 80 °C, and 100 °C. After treatment, approximately 100 g of seeds were sown in three plastic trays, each containing 2 kg of vermiculite. The entire experiment was conducted under controlled room conditions. Seedling growth was monitored by counting the number of leaves at two-day intervals. Results indicated that the height number of seedlings germinated in the group treated with 80 °C water for 10 minutes, followed by treatments at 60 °C, 100 °C, 40 °C, and 20 °C. The results suggest that a moderate temperature of 80 °C for 10 minutes is most conducive to seedling establishment in *F. semialata*.

Keywords: *Flemingia semialata*, water temperature, germination

1. Introduction

Lac insects, a critical component of the lac ecosystem, thrive on more than 400 plant species, including *F. semialata* (Sharma *et al.*, 2006) ^[1]. *Flemingia semialata*, a nitrogen-fixing leguminous species, plays an important role in agroforestry systems by improving soil fertility and supporting biodiversity. While environmental factors such as soil type and light are well-documented, the impact of water temperature on the germination and early growth of *F. semialata* remains less understood. Germination is a critical phase for successful establishment, and water temperature affects enzymatic processes and metabolic rates in seeds. This study aims to investigate how varying water temperatures influence the seedling germination of *Flemingia semialata*.

2. Materials and Methods**2.1 Seed Collection and Preparation**

F. semialata seeds were collected from the ICAR-National Institute of Secondary Agriculture, Ranchi, Jharkhand. Prior to the experiment, the seeds were soaked in running tap water for 5 minutes to remove unhealthy seeds and debris, ensuring that only healthy seeds were used in the experiment.

2.2 Water Temperature Treatments

The seeds of *F. semialata* were subjected to five water temperature treatments, each with three replicates. The temperature treatments were set at five distinct levels: 20 °C, 40 °C, 60 °C, 80 °C, and 100 °C. Additionally, each temperature was tested for three different durations: 5 minutes, 10 minutes, and 15 minutes. The experimental design aimed to evaluate the effect of varying temperatures and treatment durations on seed performance.

Water was heated and poured into glass beakers, and the temperatures were checked using a thermometer. The washed *F. semialata* seeds were added to the water in the beakers, with each beaker corresponding to a specific temperature treatment. Three beakers were used for each temperature condition. To maintain the desired water temperature, the beakers containing the seeds were placed in temperature-controlled incubators. The temperature was

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regularly monitored using digital thermometers to ensure consistent conditions throughout the experiment.

2.3 Seed Sowing and Data Collection

The treated seeds were transferred to plastic trays filled with vermiculite to provide a consistent nutrient medium for seedling germination. After one week, the number of growing seedlings was counted at two-day intervals for up to 4 weeks. The recorded seedling counts were used to analyse the performance of the seedlings under different temperature treatments and time durations.

3. Results

The seed treatment of *F. semialata* at varying temperatures and durations significantly influenced seedling performance. The number of seedlings was recorded over a period of four weeks, revealing notable trends in germination success. Seed treatments at 80 °C for 15 minutes demonstrated the highest seedling performance, followed by 60 °C, 100 °C, and 40 °C treatments. In contrast, the lowest seedling germination was consistently observed in treatments at 20 °C, regardless of the duration. These findings suggest that

higher temperatures, within a certain range, enhance the germination and early growth of *F. semialata*, while lower temperatures inhibit seedling establishment.

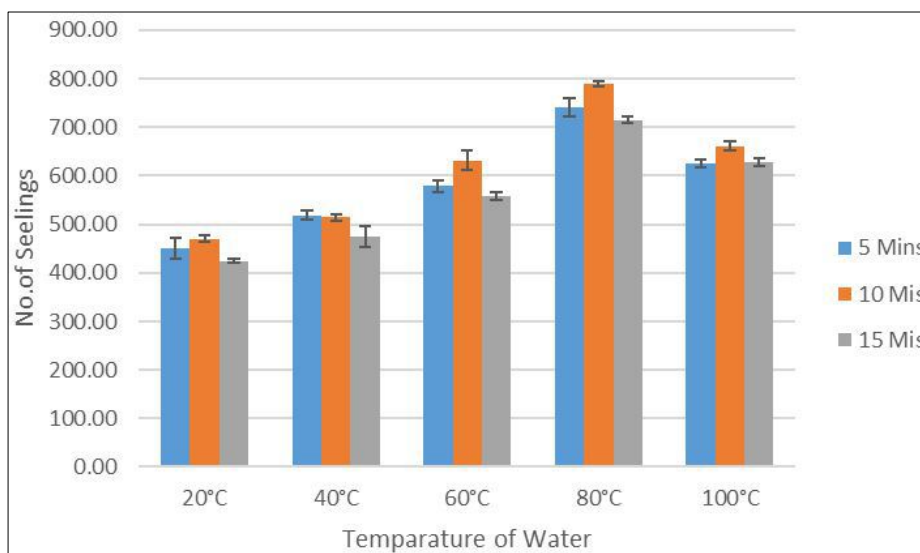
4. Discussion

Temperature plays a critical role in determining the duration of seed germination (Seefeldt *et al.*, 2002) [2]. The results of this study indicate that *F. semialata* seeds exhibit optimal germination at 80 °C. The temperature sensitivity observed in the germination process is consistent with other leguminous species, which often show peak germination at moderate temperatures. The decline in germination at 100 °C could be attributed to temperature-induced stress, which interferes with metabolic processes required for seedling development. Higher temperatures accelerate metabolic activity, potentially leading to faster depletion of seed reserves (Roberts, 1988) [4], while lower temperatures may slow enzymatic activity and reduce water uptake, delaying germination (Bewley & Black, 1994) [3]. These findings suggest that *F. semialata* is best suited for regions with moderate, stable temperatures that support faster germination and vigorous seedling growth.

Table 1: Germination performance of *Flemingia semialata* seedlings under different water temperatures and durations.

Temperature	Duration of treatment		
	5 Minutes	10 Minutes	15 Minutes
20 °C	450.00±21.66 ^d	470.67±6.57 ^d	424.67±4.84 ^d
40 °C	518.33±9.94 ^c	514.00±6.08 ^c	475.00±21.83 ^d
60 °C	578.67±11.79 ^c	631.67±19.94 ^b	557.33±8.25 ^c
80 °C	740.00±19.01 ^a	790.67±5.36 ^a	715.00±6.56 ^a
100 °C	626.33±7.69 ^b	661.67±10.14 ^b	628.00±7.77 ^b

Data are expressed as mean ± standard error. Means with the same superscript letter in the column are not significantly different.



Graph 1: Effect of Water Temperature and Duration on Seedling Germination of *F. semialata*

5. Conclusion

This study demonstrates that temperature and treatment duration significantly affect the germination and early growth of *Flemingia semialata* seeds. The optimal temperature for seedling performance was observed at 80 °C for 15 minutes, while lower temperatures, particularly 20 °C, resulted in the poorest germination rates. The results suggest that *F. semialata* seedlings benefit from higher treatment temperatures, but excessive heat, such as 100 °C, can induce stress and hinder germination. Additionally,

cooler temperatures (e.g., 20 °C) may impede enzymatic activity and water uptake, leading to delayed or poor germination. This study provides valuable insights for optimizing seed treatment protocols for *F. semialata* and similar species to enhance their propagation and early development.

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