

Influence of Different Temperatures on Germination of Sweet wormwood (*Artemisia annua* L)

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Abstract

Artemisia annua is an annual plant, initially a wild plant but now cultivated for its anti-malarial and other antimicrobial activities. Germination is one of the important stages of growth and development in plants, often regulated by internal and external factors. The research aimed at determining the temperature suitable for the germination of *Artemisia annua*. This study was conducted at the federal university in Birnin Kebbi, a permanent site in the Kalgo local government area of Kebbi state. One hundred and fifty (150) seeds of *Artemisia annua* were put into three petri dishes after placing a wet filter paper; each was placed at 35°C, 37°C, and 25°C, and the treatments were replicated three times each. And observations were made at 24-hour intervals. Speed, percentage, and mean germination time were computed according to standard procedures and protocols of the International Plant Genetic Resource Institute (IPGRI). Temperature significantly (P 0.05) affected the germination of the seed of *Artemisia annua* L. The highest percentage of 29.9 was observed at 25°C, and the lowest percentage of 0.35 was observed at 35°C. However, speed and mean germination time were all significantly affected by temperature. In conclusion, the present study revealed that seeds of *Artemisia annua* L germinate best at 25°C. Therefore, *Artemisia annua* L can be grown in sub-Saharan countries for its efficacy in the treatment of malaria.

Keywords: *Artemisia annua*, germination, influence, temperature

1.0 Introduction

The plant *Artemisia annua*, which is a member of the Asteraceae family, is grown to make anti-malarial medications. One of the crucial phases of plant growth and development is germination, which is frequently controlled by external as well as internal factors including hormones and environmental variables (moisture, temperature, humidity, etc.) [1].

One of the most important factors in germination is temperature, and different plant seeds require varied temperatures for the germination process. The distribution of plants geographically, the characteristics of the seeds, or the makeup of biological components like hormones and other phytochemicals [2].

The physiological processes of plant growth and development, including germination, depend on

temperature, and since *Artemisia annua* L is a native of Asia and other temperate regions of the planet, it is particularly crucial. The short-day plant *Artemisia annua* L has an upright stem, brownish or violet-brown leaves, and short days. In nature, the plant can reach a height of 30 to 100 cm, depending on the available climatic conditions. *Artemisia annua* 's 3-5 cm long leaves are divided into two or three tiny leaflets by deep incisions. Characteristic of the leaves is their intense aroma[3].

The most deadly parasite species, *Plasmodium falciparum*, has been found to be resistant to nearly all regularly used anti-malarial medications, including amodiaquine, mefloquine, quinine, and especially chloroquine and sulphadoxine-pyrimethamine [4]. Both conventional and traditional medicine have shown that *Artemisia annua* is beneficial in

treating malaria and other anti-microbial actions. In Chinese traditional medicine, *Artemisia annua* is frequently used to cure malaria[5]. Thus, it is necessary to produce the plant in Africa to offset the high costs of effective antimalarial medications and to provide traditional medicine for individuals who lack access to modern treatment [4].

Artemisinin derivatives are the only class of anti-malaria agents to which *Plasmodium falciparum* resistance has been reported in Africa [6]. *Artemisia annua* is native to Asia and not found in Africa or Nigeria in particular. Hence the need to use different temperatures to have an insight into the optimal temperature for the germination of its seed.

2.0 Materials and Methods

2.1 Study Area

This study was conducted at the Biology Research Laboratory, Department of Biological Sciences, Federal University Birnin Kebbi, permanent site, Kalgo local government area of Kebbi state, Nigeria. The site is located at latitude 12° 27'13" N 4° 12'01" E and longitude 12.253610N 4.2. The topography of the area is slightly undulating with compact stony brown sandy soil. It has a savannah types of vegetation with two major seasons, the dry season from November to April and rainy season from May to October. The winter is generally characterized by heavy cold and dust. The mean annual temperature is 28.4°C. About 807 mm of precipitation falls annually [7].

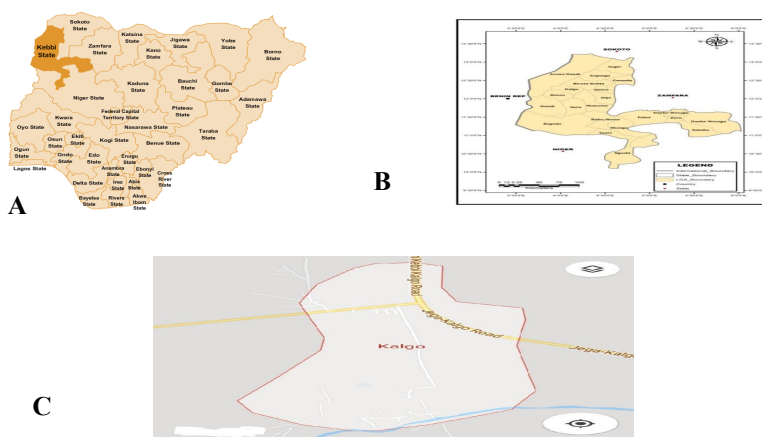


Figure 1: A: Map of Federal Republic of Nigeria B: Map of Birnin Kebbi, Kebbi State C: Map of Kalgo town

2.2 Germination Studies

The seed of *Artemisia annua* obtained from Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto. The seeds were identified in the herbarium of Department of Biological Sciences Federal University Birnin Kebbi with the voucher number FUBK-2021-87. One hundred and fifty seeds of *Artemisia annua* were put into three petridishes after placing a wet filter paper, each were placed under 35°C, 37±2C and 25°C, according to Basahy [13] protocol with title modifications. The treatments werereplicated three times each. Observation was made at 24 hours intervals. The germination

parameters were compared according to Kung et al. [8].

2.2.1Determination of Germination Percentage

Percentage of germination was determined following the method of IPGRI [9].

$$\text{Germination Percentage} = \frac{\text{Number of Seeds Germinated}}{\text{Total Number of Seeds Tested}} \times 100 \dots\dots\dots 1$$

2.2.2 Determination of Mean Germination Time

The mean germination time was calculated by the expression

$$MGT = \frac{\sum(n_i * t_i)}{\sum n_i} \dots \dots \dots 2$$

Where:

n_i = Number of seeds germinated on day i

t_i = Time in days (or hours) from the start of the test to day i

$\sum n_i$ = Total number of seeds germinated [9].

2.2.3 Speed of Germination

Speed of germination was calculated by the following formula given

Speed of Germination (SG)

$$= \frac{ni \text{ on Day 1}}{1} \times \frac{ni \text{ on Day 2}}{2} + \frac{ni \text{ on Day 3}}{3} \dots \dots 3$$

Where

n_i = number of seed germinated in the first time (number correspondent to the observation) [9]

2.2.4 Data Analysis

The data obtained was subjected to one-way analysis of variance (ANOVA). Using PAST 3 Statistical Package, the mean was separated using Duncan multiple range.

3.0 Results

3.1. Percentage of Germination

Temperature significantly ($P < 0.05$) affected the germination of *Artemisia annua L.* The percentage of 29.94% was recorded at 25°C. The lowest percentage of 0.35 was observed at 35°C (Figure 2).

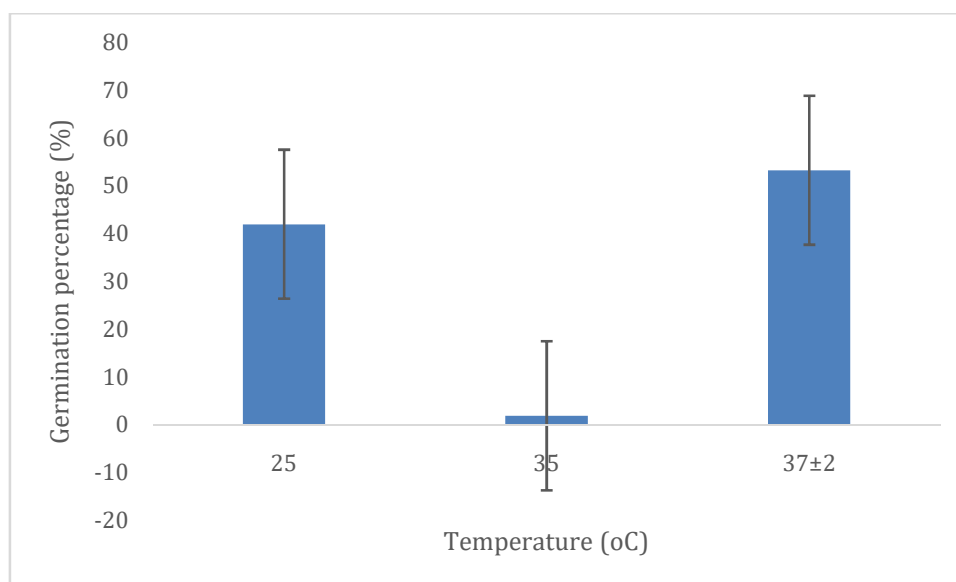


Figure 2: Parentage Germination of *Artemisia annua L* under different Temperature (representing mean and standard deviation)

3.2 Mean Germination Time

It was observed that the germination of *A. annua* was affected by temperature significantly

($p < 0.05$) the highest mean germination time of 47.23 d was recorded at 25°C and lowest mean germination time of 2.63d was observed at 35°C (figure 3).

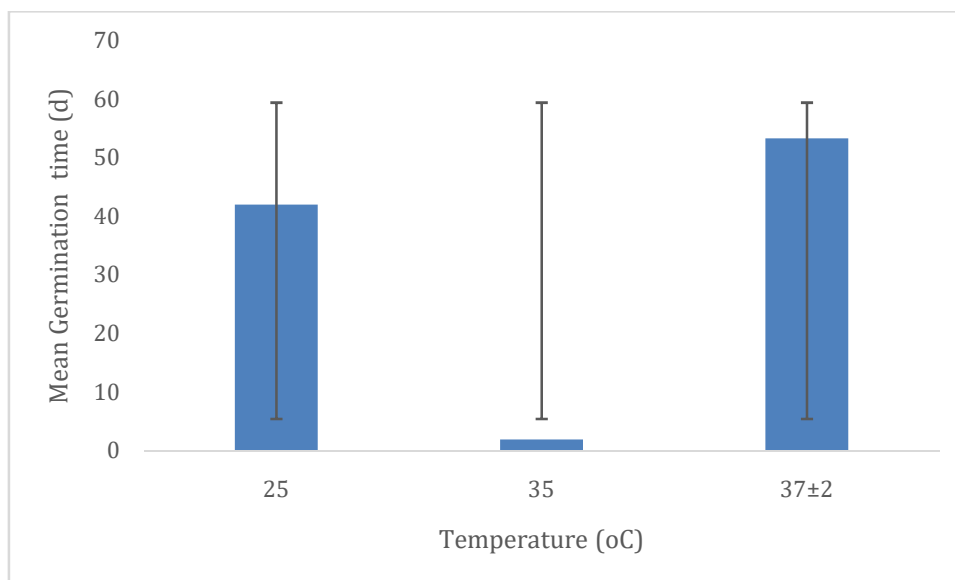


Figure 3: Mean Germination Time of *Artemisia annua L* under different Temperature (representing mean and standard deviation).

3.3 Speed of Germination

It was observed that the temperature significantly ($P < 0.5$) effected the germination of *Artemisia annua L*. The highest germination speed of 53.29

d^{-1} was recorded at $37 \pm 2^{\circ}C$ (room temperature), and the lowest germination speed of $1.93 d^{-1}$ was observed at $35^{\circ}C$ (Figure 4).

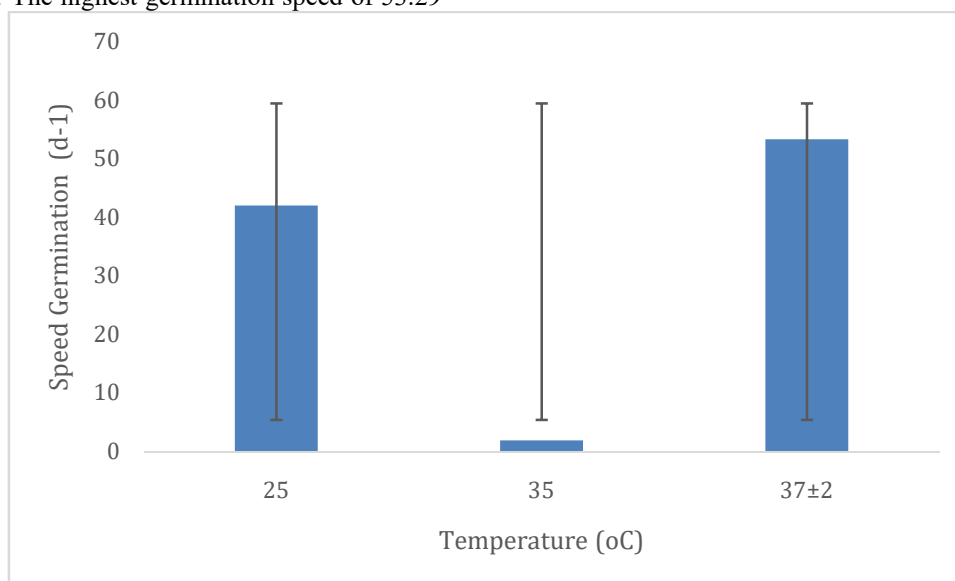


Figure 4: Speed of Germination of *Artemisia annua L* under different Temperature (representing mean and standard deviation).

4.0 Discussion

The present study analyzed the effects of different temperatures and soil types on the germination of seeds of *Artemisia annua L*. The statistics reveal that the temperature, number of

days to count, and their interaction were highly significant to the rate of germination of *Artemisia annua L*, which shows that the germination percentage varies depending on the temperature (Figures 2, 3, and 4)[3] Brown, (2010) reported

that temperature, soil type, and number of days to count were regarded as fixed factors for comparing the estimates of different test parameters [2]. However, [10] Chaturvedi et al. (2014) the seed germination (%) of *A. annua* showed optimum seed germination in alternate day/night temperature (25 °C/20 °C) ranged from 72.0±9.9 to 84.0±3.1. Similar trend has been reported for few forest species [11, 12].

Germination responses of *A. annua* indicated 30/20 °C as the most favourable temperature [13]. Other studies also reported stimulated seed germination in response to alternating high and low temperature [14]. Alternating temperature creates a shift in the inhibitor-promoter balance where the inhibitor is decreased during low temperature cycle and promoter increases during high temperature leading to germination [15].

The results obtained from the study shows that the temperature significantly ($P < 0.05$) affected the germination of *Artemisia annua* L. The highest percentage germination of 29.94% was recorded at 25°C and the lowest percentage of 0.35 was observed at 35°C.

It was also observed that the germination of *Artemisia annua* L was affected by temperature significantly ($P < 0.05$) the highest mean germination time of 47.23 was recorded at 25°C and lowest mean germination time of 2.63 was observed at 35°C. This is in line with the findings of [16] who revealed that the growers of *Artemisia annua* L can germinate seed at a temperature regime of about 15/25°C.

In the same vein it was also observed that the temperature significantly ($P < 0.5$) effected the speed germination of *Artemisia annua* L. The highest germination speed of 53.29 was recorded at 37°C and the lowest germination speed of 1.93 was observed at 35°C. Which is in contrast to the findings of [17] who recorded the highest speed at 25°C.

5.0 Conclusion

In conclusion the present study revealed that seeds of *Artemisia annua* L germinate best at 25°C. Therefore, *Artemisia annua* L can be grown in sub-Saharan country for its efficacy in treatment of malaria.

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