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Comparative Effect of Wet and Dry Heat Methods on *Afiziella africana* Seed Emergence and Germination of different Temperature and Durations

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Abstract
This study investigated the effects of wet and dry heat treatments on the germination and early growth of *Afiziella africana*, a tropical African plant species with hard seeds. The experiment tested five temperature levels (10°C, 20°C, 30°C, 40°C, and 50°C) and three exposure durations (10, 20, and 30 minutes) to assess seed emergence and seedling development after five days of planting. Results showed that temperature and heat treatment methods significantly ($P< 0.05$) influenced germination. The highest seed emergence (13 seeds) occurred at 20°C with a 10-minute treatment, while the lowest (7 seeds) was recorded at 40°C for 30 minutes. At 10°C and 50°C, emergence remained consistent across all time intervals. Wet heat treatment reduced seedling height over time (from 20.45 ± 3.56 cm to 14.78 ± 3.17 cm) but enhanced leaf development at lower temperatures—producing a higher mean leaf count (16.00 ± 2.74) compared to dry heat (12.20 ± 2.17) at 10°C. Additionally, wet treatment at 10°C resulted in greater seedling width (1.40 ± 0.07 cm) than dry heat (1.20 ± 0.17 cm). The findings highlight that both wet and dry heat, along with temperature variations, critically affect *Afiziella africana* germination and early growth. Optimal conditions (moderate temperatures and shorter heat exposure) improved emergence, while extreme temperatures or prolonged heat reduced success. These insights are valuable for improving seed pretreatment methods in agriculture and ecological restoration, particularly for hard-seeded tropical species. Further research could explore long-term growth responses to refine cultivation practices.

Keywords*: Afiziella africana*, germination, heat, seeds, temperature
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Introduction

Afzelia africana is a large deciduous tree with a spreading crown, to 30 (-35) m tall in forests and 10-18 m tall in savannah. It belongs to the family Fabaceae (sub family-Ceasalpinoidae) in the order Fabales. It is a large tree with a spreading crown having height that varies from 10 to 20 m and a mean diameter of 36 cm *(*Akram *et al.*, 2023*)*.The fast rates of vegetal loss and degradation recorded across the tropics have continued to increase both the fragmentation of many populations and the risk of species' extinction. In Nigeria as elsewhere, conservation of forest genetic resources is achieved through the protection of these resources in their natural habitat (in situ) or preservation of samples of the genetic diversity of endangered species away from their field habitats *(ex situ)* in facilities such as botanical gardens, seed gene banks, in-vitro gene banks, and field gene banks *(*Raza,*et al.*,2023) In its natural ecosystem, *A. africana* relies on stochastic environmental events, such as fire or prolonged exposure to high soil temperatures, to fracture the seed coat and facilitate germination. This ecological adaptation points to the

application of heat as a biologically relevant pre-germination treatment. Heat treatments can be broadly categorized into dry heat (oven-drying) and wet heat (hot water immersion). Both methods aim to disrupt the macrosclereid layer of the seed coat, but they are hypothesized to do so through different mechanisms and with varying degrees of efficacy and safety for the seed embryo (Van Staden *et al.,* 2019).

While numerous studies have investigated various pre-sowing treatments for *A. africana*, including mechanical and chemical scarification, a direct, systematic comparison between wet and dry heat methods under controlled temperature and duration regimes is lacking. Existing literature often reports conflicting results or focuses on a single method without a comparative framework (Adebisi *et al.*, 2020). This gap is critical because the choice of method has practical implications. Dry heat is logistically simpler, but risks damaging the embryo through desiccation or extreme temperatures. Wet heat is more common but its effectiveness is highly dependent on the precise combination of water temperature and exposure duration; insufficient heat fails to break dormancy, while excessive heat can cook the seed, causing embryo death (Tieu *et al*., 2001).

The seed propagation of most tropical tree species especially *Afzelia africana* however, is constrained by recalcitrant seed germination as a result of dormancy *(*Akram *et al*., 2023*).* The degree of dormancy makes it difficult for seed to germinate evenly and adequately. In both the forest and savanna ecosystems of Nigeria. This study was therefore carried out to determine the effect of wet and dry heat treatment in breaking seed dormancy (emergence) in *Afzelia africana.,*

Materials and Methods

Procurement and viability test of the seeds

The main seeds of *Afzelia africana (Sm. Ex pers)* were purchased from Gboko market in Benue state, Nigeria. It was authenticated by a Botanist in the Department of Biological Sciences, Nigeria Police Academy Wudil, Kano. The viability of the seeds was tested in accordance with the methods of Germ (1975) and Akram *et al*., (2023).

Experimental Design and procedure

The study consist of two seed hardness breaking methods treatment experiment which were arranged as 2x5x3 factorial treatment structure in a completely randomized design (CRD), giving a total of 30 experimental units. The seed hardness breaking method heat treatment factor were represented as:

A- Wet heat method experiment,

B- Dry heat method experiment, the seeds treated with wet and dry heat respectively.

Five (5) Temperature regulated intervals factor and three (3) Time regulated factor in minutes were used.

Experimentation

Five seeds from group A were treated with Wet heat at various temperature intervals of 10°C, 20°C, 30°C 40°C and 50°C and each for the duration of 10, 20 and 30 minutes .The same number of seeds were also used for group B, and were treated with Dry heat using an oven, where seeds are placed in sterilized non- disposable petri dish and kept in the oven at the temperature intervals of 10°C, 20°C ,30°C, 40°C and 50°C, for same duration in minutes .A folded wire gauze with a handle was used in removing the seeds from boiling water during wet treatment experiment in to separate containers with distilled water for 5 minutes, and therefore spread to be sun-dried and preserved for seed germination test and same was also done for dry heat experiment excluding the use of wire gauze. The seeds planting experiment were performed in 155 polythene pots including 5 control all packed with composited sandy-loam soil with an ambient temperature of 24°C. Five (5) seeds per pot were planted at a depth of 3cm for all the replicates. The potted seeds and seedlings were lightly watered twice a day (morning and evening) to ensured adequate water supply for germination. Seeds were considered to have germinated when the tips of the radical has grown free above the soil, and the percentage

rate of germination (in term of number of leaves and height) for each plant category were also recorded and calculated at the interval of four (4) days after germination .The number of leaves was calculated using the formula prescribed by Abubakar and Maimuna (2013) and height of plant

$$NL = \frac{TNL}{TSEM}$$

Where: NL = Number of leaves

TNL = Total number of leaves on a particular plant

TSEM = Total number of seeds emerged.

Data analysis

All the data collected during the study were used to calculated, the means with their std in duplicate and Fishers Least Significance Differences (FLSD) was used to test their level of significance using Statistical Package for Social science (SPSS) version 23.

Results

The experimental result presented in Table 1 explores the influence of different temperatures and time intervals on seed emergence after five days of planting. The result displays data for five temperature levels (10°C, 20°C, 30°C, 40°C, and 50°C) and three time intervals (10 minutes, 20 minutes, and 30 minutes) after 5 days of planting. Seed emergence was measured at three different time intervals: 10, 20, and 30 minutes after 5 days of planting. The total counts for seed emergence at each temperature and time combination reveals that, the highest total seed emergence occurred at 20°C and 10 minutes (13 seeds), while the lowest total seed emergence was observed at 40°C and 30 minutes (7 seeds). At 10 and 50°C, there were a consistent seed emergence (SDE) across the different time intervals (10, 20, and 30 mins) having the total seed emergence of 10 each, with a corresponding percentage of 20%. This suggests that the seeds at these temperatures are relatively responsive, showing a consistent emergence pattern. And at 20°C, the percentage seed emergence (SDE) of 26% was recorded, which indicates that the seeds at this temperature respond well to the experimental conditions, with a peak at 10 minutes, however, at 40°C the number of emerging seeds decreases.

The results of the mean effect of treatment and temperature on the height of *Afiziella africana* in relation to time in minutes is presented in Table 2a. The results suggest that both treatment and temperature have an impact on the height of *Afiziella africana* over different time intervals. Wet treatment resulted in a decrease in height from 20.45±3.56 (cm) to 14.78±3.17 (cm) over time, while dry-heat treatment showed variation. The effect of temperature on plant height varied across different temperatures and time intervals, with some temperatures showing significant differences most especially at 30 mins. The interaction effect between treatment and temperature on the height of *Afiziella africana* over different time intervals (10mins, 20mins, and 30mins) is presented in Table 2b. The experiment involved wet treatment and dry-heat treatment under various temperature conditions (10°C, 20°C, 30°C, 40°C, and 50°C). At 10°C, the wet treatment resulted in a plant height of 22.38±0.11 (cm) at 10 mins, meanwhile the dry-heat treatment showed a slightly higher height of 23.66±4.03 (cm). As the time increased to 30 mins, both treatments exhibited a significant increase in height, with the wet treatment reaching 17.48±1.43 cm and the dry-heat treatment reaching 24.64±9.06 cm. Moving to 20°C, the wet treatment started at 21.42±0.18 cm and showed a decrease to 17.04±0.16 cm at 30 mins. On the other hand, the dry-wet treatment displayed a fluctuating pattern, starting at 21.30±9.22 cm and ending at 16.62±3.68 cm. At 30°C, the wet treatment demonstrated a notable increase in plant height of 22.90±5.03 cm at 10 mins, in contrast, the dry-heat treatment exhibited a decrease in height over the same period. The impact of temperature becomes more evident at higher levels most especially at 40°C and 50°C where both wet and dry-heat treatments resulted in decreased plant heights over time.

The result presented in Table 3a, provides a comprehensive overview of the effects of treatment and temperature on the number of leaves of *Afiziella africana* over different time intervals (10 minutes, 20 minutes, and 30 minutes). The temperature of 20°C seems to have a positive effect on leaves count (17.80±3.22) compared to other temperatures at 20 minutes. Generally, there seems to be a decreasing trend in leaves count with increasing temperature, the results showed that both treatment type and temperature have significant effects on the number of leaves of *Afiziella africana*, and the interaction between treatment and temperature should be considered for a comprehensive understanding.

Table 3b meticulously documents the mean number of leaves under different treatments and temperatures, shedding light on the intricate interplay between these variables. At 10°C, the wet treatment yields a mean leaf count of 16.00 ± 2.74, whereas the dry-heat treatment results in 12.20 ± 2.17. The statistically significant difference ($p < 0.05$) suggests that wet treatment is more conducive to leaf production at this temperature. As the temperature increases to 20°C, the wet treatment still prevails, producing 17.20 ± 3.11 leaves compared to 17.60 ± 2.41 in the dry-heat treatment. Interestingly, at this temperature, the wet treatment leads to a higher mean leaves count, contrasting with the 10°C findings. The impact of temperature intensifies at 30°C, where the wet treatment outperforms the dry-heat treatment significantly (20.60 ± 7.40 vs. 8.60 ± 2.41, $P< 0.05$). This indicates that higher temperatures of 30°C favor the wet treatment for leaf production in *Afiziella africana*. However, at 40°C and 50°C, the dry-heat treatment surprisingly rebounds, showing higher mean leaf counts compared to the wet treatment.

Tables 4a and 4b presented a comprehensive data regarding the width (cm) of *Afiziella africana* under different experimental conditions. The study investigates both wet treatment and dry-heat treatment, exploring their effects over three different time intervals. Additionally, the temperature variations studied range from 10°C to 50°C. The results indicate that under wet treatment conditions, there is no significant difference in the width of Afiziella africana across the different time intervals (10mins, 20mins, and 30mins). The mean width (cm) values remain relatively constant, suggesting that the duration of wet treatment does not significantly influence the morphology of *Afiziella africana*. Dry-heat treatment, on the other hand, shows a similar trend with no significant differences in width across the three time intervals. The mean width values for dry-heat treatment are consistently around 1.35 ± 0.12 cm. Temperature variation has a more pronounced effect on the width of *Afiziella africana*. At 10°C, 20°C, and 30°C, the differences in mean width (cm) values are not statistically significant. However, at higher temperatures (40°C and 50°C), there were notable variations. At 40°C, the width decreases significantly, with a mean value of 1.30 ± 0.08 cm, meanwhile at 50°C, there was a slight increase in width compared to 40°C but still significantly lower than the lower temperatures. The results in Table 4b indicated a significant interaction between treatment methods and temperature on the width/breadth of *Afiziella africana*. The findings reveal that the width/breadth (cm) measurements demonstrate a temperature-dependent response. At 10°C, wet treatment yields a width of 1.40 ± 0.07 cm, while dry-heat treatment results in a slightly narrower width of 1.20 ± 0.17 cm. Conversely, at 30°C, wet treatment produces a width of 1.44 ± 0.09 cm, surpassing the dry-heat treatment width of 1.40 ± 0.14 cm. Across all temperatures, variations in treatment duration (10, 20, and 30 minutes) lead to subtle differences in width/breadth (cm). For instance, at 20°C, wet treatment for 10 minutes results in a width of 1.30 ± 0.00 cm, while the same treatment for 30 minutes produces a width of 1.42 ± 0.08 cm. The interaction between treatment methods and temperature is evident when comparing wet and dry-heat treatments at each temperature level. At40°C, for example, wet treatment yields a width of 1.32 ± 0.13 cm, while dry-heat treatment results in a slightly wider width of 1.36 ± 0.13cm.

Table 1: Effect of treatment on the Seed emergence in relation to various Temperatures (ºC) and Time (minute) after 5 days of planting

Temperature (ºC)	Seed Emergence at Regulated Time(min) [10]	[20]	[30]	Total Freq.	% SDE
10	4	3	3	**10**	**20**
20	5	4	4	**13**	**26**
30	3	2	5	**10**	**20**
40	4	2	1	**07**	**14**
50	4	5	1	**10**	**20**
Total	**20**	**16**	**13**	**50**	

Note: % SDE = Percentage seed emergence = Number of individual total frequency of seed emergence **/ Grand**Total seeds emergence x100

Table 2a: Main Effect of Treatment and Temperature on the Height of *Afiziella africana* in relation to time (Minute)

Treatment	Plant Height (cm)		
	10mins	**20mins**	**30mins**
Wet treatment	20.45±3.56	19.02±3.68	14.78±3.17
Dry-heat treatment	19.74±5.31	18.69±4.38	18.90±5.99
FLSD(0.05)	NS	NS	3.110
Temperature	23.02±2.77[a]	18.44±0.24	21.06±7.18[cd]
10°C			
20°C	21.36±6.15	21.34±4.09[b]	17.01±2.49
30°C	20.09±5.45	18.75±2.88	14.67±4.79[c]
40°C	18.76±3.19	17.15±2.79[b]	13.81±5.16[d]
50°C	17.26±1.41[a]	18.60±2.09	17.64±1.61
FLSD(0.05)	**4.995**	**3.260**	**6.670**

Values are Mean ± standard deviation in duplicates. Mean values with similar alphabets are statistically significant.
NS=No significant difference. FLSD = Fisher's Least Significant Difference

Table 2b: **Interaction Effect between Treatment and Temperature on the Height of *Afiziella africana* in relation to time in minute**

Temperature	Treatment	Plant Height (cm) 10mins	20mins	30mins
10°C	Wet Treatment	22.38±0.11	13.30±0.16[b]	17.48±1.43[d]
	Dry-heat treatment	23.66±4.03	23.58±4.83[b]	24.64±9.06[d]
20°C	Wet treatment	21.42±0.18	22.98±0.24	17.04±0.16
	Dry-wet treatment	21.30±9.22	19.70±5.55	16.62±3.68
30°C	Wet treatment	22.90±5.03[a]	21.24±1.75[c]	11.30±0.16[e]
	Dry-heat treatment	17.28±4.66[a]	16.26±0.15[c]	18.04±4.81[e]
40°C	Wet treatment	18.58±4.08	18.52±2.84	10.92±0.59[f]
	Dry-heat treatment	18.94±2.47	15.78±2.19	16.70±6.22[f]
50 °C	Wet treatment	16.98±1.07	19.06±1.70	16.78±1.12

	Dry-heat treatment	17.54±1.77	18.14±2.52	18.64±1.66
FLSD (0.05)		**3.776**	**3.000**	**4.911**

Values are Mean± standard deviation in duplicates. Mean values with similar alphabets are significant

Table 3a: Main Effect of Treatment and Temperature on the Number of Leaves of *Afiziella africanain relation to time (minute)*

	No of leaves		
Treatment	**10mins**	**20mins**	**30mins**
Wet treatment	16.16±4.73	14.80±5.41	11.44±2.92
Dry-heat treatment	14.24±4.51	14.28±4.12	13.80±6.06
FLSD(0.05)	NS	NS	1.333
Temperature			
10°C	16.00±2.74	15.80±4.42^{a}	15.80±5.29^{c}
20°C	17.40±3.78	17.80±3.22^{b}	11.90±6.22
30°C	14.60±8.18	13.00±6.55	11.40±3.74
40°C	15.30±3.06	10.80±2.70^{ab}	9.90±2.51^{c}
50°C	12.70±2.41	15.30±3.34	14.10±3.96
FLSD (0.05)	**NS**	**4.001**	**4.697**

Values are Mean ± standard deviation in duplicates. Mean values with similar alphabets are significant. NS significant difference.

Table 3b: Interaction Effect between Treatment and Temperature on the Number of Leaves of *Afiziella africana* in minute

Temperature		**No of leaves**		
	Treatment	**10mins**	**20mins**	**30mns**
	Wet treatment	16.00 ± 2.74	12.20 ± 2.17^{c}	12.00 ± 0.00^{c}
10°C				
	Dry-heat treatment	16.00 ± 3.67	19.40 ± 2.69^{a}	19.60 ± 5.18^{a}
	Wet treatment	17.20 ± 3.11	19.80 ± 2.49	9.40 ±1.67^{e}
20°C				
	Dry-heat treatment	17.60 ± 2.41	15.80 ± 2.68	14.40 ± 8.47^{b}
	Wet treatment	20. 60 7.40^{a}	15.60 ± 8.76^{b}	9.00 ± 0.00
30°C				
	Dry-heat treatment	8.60 ± 2.41^{b}	10.40 ± 1.67^{c}	13.80 ± 4.15
	Wet treatment	14.80 ± 1.79	10.40 ± 2.19	12.00 ± 0.00
40°C				
	Dry-heat treatment	15.0 ± 4.15	11.20 ± 3.35	7.80 ± 1.79
	Wet treatment	12.20 ± 3.35	16.00 ±4.06	14.80 ± 4.55
50°C				
	Dry-heat treatment	13.20 ± 1.10	14.60 ± 2.70	13.40 ± 3.65
FLSD (0.05)		**10.000**	**4.933**	**4.796**

Values are Mean ± standard deviation in duplicates.
Means values with different superscripts within the column are significantly different

Table 4a: Main Effect of Treatments and Temperature on the Width of *Afiziella africana*

	Width/Breath (cm)		
Treatment	**10mins**	**20mins**	**30mins**
Wet treatment	1.38 ± 0.11	1.32 ± 0.11	1.37 ± 0.10
Dry-heat treatment	1.34 ± 0.15	1.35 ± 0.14	1.37 ± 0.12
FLSD(0.05)	NS	NS	NS
Temperature			
10°C	1.30 ± 0.16	1.30 ± 0.15	1.37 ± 0.14
20°C	1.31 ± 0.07	1.36 ± 0.12	1.38 ± 0.09
30°C	1.42 ± 0.11	1.41 ± 0.13	1.45 ± 0.08[a]
40°C	1.34 ± 0.13	1.28 ± 0.11	1.30 ± 0.08[b]
50°C	1.43 ± 0.14	1.28 ± 0.09	1.34 ± 0.11
FLSD(0.05)	**NS**	**NS**	**0.100**

Values are Mean ± standard deviation in duplicates.
Means values with different superscripts within the column are significant.
NS = No significant difference

Table 4b: Interactions Effect between Treatment and Temperature on the Width/Breadth (cm) of *Afiziella africana*

		Width/Breadth(cm)		
Temperature	**Treatment**	**10mins**	**20mins**	**30mins**
10°C	Wet treatment	1.40 ± 0.07[a]	1.26 ± 0.05	1.28 ± 0.04[a]
	Dry-heat treatment	1.20 ± 0.17[b]	1.34 ± 0.21	1.46 ± 0.15[b]
20°C	Wet treatment	1.30 ± 0.00	1.42 ± 0.08	1.42 ± 0.08
	Dry-heat treatment	1.32 ± 0.11	1.30 ± 0.12	1.34 ± 0.09
30°C	Wet treatment	1.44 ± 0.09	1.42 ± 0.13	1.48 ± 0.04
	Dry-heat treatment	1.40 ± 0.14	1.40 ± 0.14	1.42 ± 0.11
40°C	Wet treatment	1.32 ± 0.13	1.26 ± 0.05	1.28 ± 0.04
	Dry-heat treatment	1.36 ± 0.13	1.40 ± 0.10	1.32 ± 0.11
50°C	Wet treatment	1.42 ± 0.16	1.26 ± 0.05	1.38 ± 0.08
	Dry-heat treatment	1.44 ± 0.13	1.30 ± 0.12	1.30 ± 0.12
FLSD (0.05)		**0.150**	**NS**	**0.101**

Values are Mean ± standard deviation in duplicates. Mean values with different superscripts within the column are significant. NS = No significant difference

Discussion

Effect of treatment on the Seed emergence in relation to various Temperatures (ºC) and Time (minute)

This study explores the influence of different temperatures and time intervals on seed emergence after five days of planting. The result displays data for five temperature levels and three time intervals. This temporal breakdown may provide insights into the kinetics of seed emergence, revealing how quickly or slowly seeds respond to the given conditions Özzambak and Erken (2022). During the study, the highest total seed emergence occurred at 20°C and 10 minutes, while the lowest total seed emergence was observed at 40°C and 30 minutes. This suggests that, the seeds at these temperatures are relatively responsive, showing a consistent emergence pattern at higher temperatures that may have adverse effects on seed germination within the observed time

frame as similarly reported by Haj Sghaier *et al.,* (2022). There was also a general increase in seed emergence with longer time intervals, indicating a positive correlation between time and seed emergence at this temperature as the impact of temperature on seed emergence also becomes more evident when comparing the different temperature levels. This positive correlation between time and seed emergence at 20°C and 10 minutes suggests that, the temperature falls within the optimal range for the germination of *Afiziella africana (*Akram *et al.,* 2023). This also indicates that the environmental conditions are conducive to the efficient functioning of biochemical and physiological processes associated with seed germination, leading to a timely and successful emergence of seedlings.

Interaction Effect between Treatment and Temperature on the Height of *Afiziella africana* in relation to time in minutes

The results of the mean effect of treatment and temperature on the height of *Afiziella africana* in relation to time in minutes during the study is aligned with results of (Khaeim *et al.,* 2022) which suggest that, both treatment and temperature have an impact on the height of *Afiziella africana* over different time intervals. The effect of temperature on plant height varied across different temperatures and time intervals, with some temperatures showing significant differences most especially at 30 mins indicating a dynamic response to temperature and treatment over time. The growth and development of plants are influenced by various environmental factors, and temperature is a critical one among them. The effects of temperature on the height of plants can be explained by considering different time intervals and the biological processes like photosynthesis, water uptake, growth rate, and reproductive development Onwuka and Mang (2018). Understanding these effects is crucial for predicting how plants will respond to short-term fluctuations, seasonal changes, and long-term shifts in temperature, especially in the context of a changing climate (Khaeim *et al.*, 2022).

Interaction Effect between Treatment and Temperature on the Number of Leaves of *Afiziella africana*

The mean number of leaves recorded under different treatments and temperatures during this study, shed light on the intricate interplay between these variables. As at 10°C, the wet treatment yields a significant higher mean leaf count than the dry-heat treatment, this statistically significant difference ($p < 0.05$) even as the temperature increases to 20°C, the wet treatment still prevails, producing higher leaves counts as compared to the dry-heat treatment. This suggests that, wet treatment may be more conducive to leaf production at this temperature (Sharmab *et al,* 2020). Wet heat is reported to act as a temperature buffer as it provides a more stable and moderate temperature environment for plant growth as reported by Zeng and Lv (2019). Meanwhile 20°C it's still within a range where some plants may benefit from as a more stable temperature, allowing them to allocate more resources for growth, including the production of leaves.

Interactions Effect between Treatment and Temperature on the Width/Breadth (cm) of *Afiziella africana*

This study presented a comprehensive data regarding the width (cm) of *Afiziella africana* under different experimental conditions. The study investigates both wet treatment and dry-heat treatment, exploring their effects over three different time intervals on the width of *Afiziella africana*. The results indicate that under wet treatment conditions, there was no significant difference in the width of *Afiziella africana* across the treatments.

Conclusion

This study demonstrates that both wet and dry heat treatments, along with varying temperatures, significantly ($P < 0.05$) influence the germination and early growth of *Afiziella africana* seeds. Optimal seed emergence was observed at 20°C with a 10-minute treatment, while higher temperatures (40°C and 50°C) reduced germination success. Wet heat treatment generally promoted better leaf development and plant width at lower temperatures (10°C), whereas

dry heat showed varying effects. These findings highlight the sensitivity of *Afiziella africana* to thermal conditions, providing crucial insights for improving seed germination strategies in agricultural and ecological applications. Further research could explore long-term growth effects under different pretreatment methods to enhance cultivation practices for this species.

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