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Full Length Research Article

# EFFECT OF PRE-SOWING TREATMENTS ON SEED GERMINATION AND GROWTH OF OKRA (*ABELMOSCHUS ESCULENTUS*) IN KAFANCHAN

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## ABSTRACT
This study investigated the effects of various pre-sowing treatments on seed germination and growth of okra (*Abelmoschus esculentus*). Conducted during the rainy season of 2024 at the Research Farm of the Faculty of Agriculture, Kaduna State University, Kafanchan campus, the study consisted of four treatments: Control (T1), soaking in water for 24 hours (T2), scarification with sandpaper (T3), and soaking in water for 24 hours followed by scarification with sandpaper (T4). The experimental design was a randomized complete block design with three replications. The results indicated significant differences in germination rates among treatments, with T4 achieving the highest rate of 88.00%, while T1 recorded the lowest at 68.33%. Seedling emergence was fastest for T2, averaging 7.33 days compared to 11.00 days for the control. However, no significant differences were observed in plant height, number of leaves per plant, or leaf area at any measurement point ($p>0.05$). At nine weeks after sowing, T4 exhibited the greatest plant height at 45.53 cm and the largest leaf area at 120.03 $cm^2$. Findings indicated that while pre-sowing treatments significantly influenced germination and seedling emergence, their effects on growth parameters such as plant height and leaf production were less pronounced. These findings underscore the importance of effective pre-sowing practices to enhance seed performance and establish robust okra crops. The study recommended that farmers should utilize soaking followed by scarification to improve germination rates, regularly monitor growth metrics to assess treatment effects over time.

**Keywords:** Pre-Sowing, Treatments, Germination, Growth, Okra Seeds.

## INTRODUCTION
Okra, *Abelmoschus esculantus* (L.), is an herbaceous plant that belongs to the *Malvacea*e family. It is native to tropical Africa and can be found growing throughout West Africa (Elkhalifa et al., 2021). It is one of the most significant fruits and vegetables in the world, grown for its immature fruits, or seed pods, which are typically 3 to 10 inches long, tapered, and have ribs running down their length. In addition to being a wonderful source of vitamins, proteins, carbs, lipids, and minerals, it also has therapeutic benefits for a variety of illnesses (Abidi et al., 2018). India leads in both output and area, with a productivity of roughly 11.90 tonnes/hour, followed by Nigeria (Osei-Amponsah, 2013). Nonetheless, Egypt is said to have the highest productivity, followed by Saudi Arabia and India. In Jammu and Kashmir, okra was grown on 3620 hectares of land in 2017–18, yielding a production of 14985 MT (Ngbede et al., 2014).

Okra can withstand cold and lows of 12°C, but it thrives in temperatures between 22 and 35°C. Okra requires a temperature range of 25 to 30°C for fruit setting, growth, and seed germination; seeds do not germinate below 20°C. Okra frequently has poor field establishment and seed germination, most likely as a result of its stiff, impermeable seed coat, which keeps seeds from taking in moisture (Kumar et al., 2016; Ebert & Wu, 2019). Poor stand establishment brought on by slow and unequal seed germination, especially in early spring planting when commercial cultivars only achieve up to 66% initial germination, is one of the causes contributing to the low okra yield (Tyagi & Khire, 2018).

Okra (*Abelmoschus esculentus*) is a highly valued vegetable because of its nutritional content and culinary variety, making it a major crop in many parts of the world. A good crop output depends on the germination and subsequent growth of okra seeds, which are the foundation for the growth of okra plants (Sheferie et al., 2023). On the other hand, a number of variables may impact the okra seeds' ability to germinate and thrive as a whole. Pre-sowing treatments, which include exposing the seeds to particular circumstances or treatments prior to planting in order to maximize their germination and growth potential, are one such factor (Vasilyev et al., 2020).

The significance of this study lies in its potential to improve the germination and growth of okra seeds, leading to more efficient and sustainable agricultural practices, and ultimately contributing to food security and the overall health of the agricultural sector. Okra is an important vegetable crop with significant nutritional value, but its germination and growth can be affected by various factors such as seed dormancy, moisture availability, and temperature. Understanding the effect of pre-sowing treatments on okra seed germination and growth is crucial for several reasons. seed germination and crop establishment, promoting uniform germination for consistent crop growth and yield, increasing seedling vigor for the overall health and productivity of the crop, and optimizing seedling establishment for efficient and sustainable agricultural practices.

Okra seeds have a hard, protective seed coat that surrounds the embryo, which consists of the radicle, plumule, and cotyledons (Rodríguez & Maiti, 2018; Ali et al., 2019). The radicle is the embryonic root that grows downward into the soil, while the plumule is the embryonic shoot that grows upward, forming the stem and leaves. According to Joshi (2018), the cotyledons are the embryonic leaves that serve as food storage organs, providing energy and nutrients for the seedling's initial growth.
The use of pre-sowing treatments to enhance seed germination

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and early plant growth has been extensively studied in a variety of plant species beyond okra. These treatments have been shown to be effective in improving various aspects of seed performance and seedling establishment, making them a valuable tool for improving crop yields and productivity.

Scarification, both mechanical and chemical, has been widely investigated as a pre-sowing treatment for improving germination in numerous plant species. Mechanical scarification, which involves physically abrading the seed coat, has been found to be effective in enhancing germination in species with hard or impermeable seed coats, such as legumes, grasses, and some tree species. For example, a study on the germination of *Acacia senegal* (gum arabic tree) seeds found that mechanical scarification using sandpaper significantly improved germination rates compared to untreated seeds (Abdalkreem et al., 2023). Increased water uptake and gas exchange facilitate the disruption of the seed coat.
Similarly, chemical scarification using acids or other corrosive agents has been shown to be effective in breaking seed dormancy and improving germination in various plant species. A study on the germination of *Prosopis juliflora* (mesquite) seeds found that soaking the seeds in sulfuric acid for 10 minutes increased germination rates by up to 80% compared to untreated seeds (Baskin & Baskin, 2014).

Soaking seeds in water or nutrient solutions has been a common pre-sowing treatment used to enhance germination and early growth in many plant species. The process of soaking helps to imbibe the seeds with water, activating metabolic processes and enzymes necessary for germination. A study on the germination of *Capsicum annuum* (bell pepper) seeds found that soaking the seeds in water for 12 hours significantly improved germination rates and seedling vigor compared to untreated seeds (Özbay, 2018). It was attributed to the increased water uptake and the activation of enzymes involved in the breakdown of stored reserves, providing the seedlings with a better start.
Seed priming, a more advanced form of soaking, has also been extensively studied for its effects on germination and early growth. Priming involves the controlled hydration and dehydration of seeds, which can help to synchronize germination and improve seedling establishment. A study on the germination of *Brassica rapa* (Chinese cabbage) seeds found that priming the seeds in polyethylene glycol solution significantly improved germination rate, seedling growth, and stress tolerance compared to untreated seeds (Shah et al., 2022).

Exposing seeds to cold temperatures, a process known as stratification, has been shown to be effective in breaking seed dormancy and improving germination in many plant species, particularly those adapted to temperate climates. A study on the germination of *Pinus sylvestris* (Scots pine) seeds found that subjecting the seeds to a cold, moist stratification treatment for 60 days significantly improved germination rates compared to untreated seeds (Houšková et al., 2021).
Similarly, a study on the germination of *Quercus rubra* (red oak) seeds found that a 90-day cold stratification treatment improved germination rates by up to 30% compared to untreated seeds (Ristau & Royo, 2020). This technique has been widely used in the propagation of many tree and shrub species with inherent seed dormancy.

This study investigated the effect of various pre-sowing treatments on the seed germination and growth of okra seeds, providing valuable insights into the potential benefits and practical applications of these treatments in okra cultivation. By examining the outcomes of different pre-sowing treatments, this research will contribute to the existing knowledge on okra seed germination and growth, ultimately supporting farmers and growers in improving their crop productivity and overall agricultural sustainability. The objective of the study therefore is to evaluate the effects of different pre-sowing treatments on the germination and growth parameters of okra.

## MATERIALS AND METHODS

### Experimental Site

The field trial was conducted during the wet season of 2024 at the Teaching and Research Farm of the Faculty of Agriculture, Kaduna State University, Kafanchan Campus (09º34'N and 08º 18' E) in the southern Guinea savannah of Nigeria. The average annual rainfall in this region is 1540mm with an average annual temperature of 24.4°C.

### Treatments and Experimental Design

The trial consisted of five treatments: Control (T1), Soaking in water for 24 hours (T2), Scarification with sandpaper (T3), Soaking in water for 24 hours followed by scarification with sandpaper (T4). It was laid out in a randomized complete block design (RCBD) and replicated three times. The gross plot size consisted of 3 rows of 3m by 2m each. There was a plot alley of 0.5m between replications.

### Data Collection and Statistical Analysis

The number of seeds that sprouted within a specified period after sowing was recorded to determine the germination rate of the okra seeds under different pre-sowing treatments, as
well as seedling emergence (days). Growth parameters were also taken at 2, 4, and 6 weeks after sowing (WAS) for plant height (cm), number of leaves/plants, and leaf area($cm^2$). These form part of the parameters for crop evaluation (Akos et al., 2016; Akos et al., 2017; Akos et al., 2021; Akos et al., 2025). All data collected were subjected to analysis of variance (ANOVA) using Statistix version 10.0 (Statistix, 1985). Differences between treatment means were compared and, where there were statistical differences, mean separation was done using Duncan multiple range test (DMRT) (Duncan, 1955).

## RESULTS

### Effects of Different Pre-Sowing Treatments on the Germination Rate and Seedling Emergence of Okra

Table 1 shows the effects of different pre-sowing treatments on the germination rate and seedling emergence of okra. The results indicate significant differences ($p<0.05$) in germination rates among the treatments. The highest germination rate observed was 88.00% for the treatment involving soaking in water for 24 hours followed by scarification with sandpaper (T4). In contrast, the control treatment (T1) exhibited the lowest germination rate at 68.33%.
Regarding seedling emergence, there were also significant differences among the treatments. The fastest seedling emergence was recorded for the treatment that involved soaking in water for 24 hours (T2), with seedlings emerging after an average of 7.33

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days. The control treatment (T1) had the slowest emergence time, taking an average of 11.00 days. There was a significant difference ($p>0.05$) between T3 and T4, which were similar to T2 and T1 for germination rate. While seedling emergence shows a significant difference between T1 and other treatments, which were all statistically similar with no difference among them (T2, T3, and T4).

**Table 1:** Effects of different pre-sowing treatments on the germination rate and seedling emergence of Okra at Kafanchan, 2024 rainy season

| Treatment | Germinate rate (%) | Seedling Emergence (days) |
|---|---|---|
| T1 | 68.33$^{c}$ | 11.00$^{a}$ |
| T2 | 76.67$^{b}$ | 7.33$^{b}$ |
| T3 | 85.33$^{a}$ | 8.67$^{b}$ |
| T4 | 88.00$^{a}$ | 8.33$^{b}$ |
| SE (±) | 2.077 | 0.653 |

*Means with different alphabet within a column were significantly different at 5% level of probability according to Duncan's multiple Range Test (DMRT), WAS= week after sowing, SE=Standard Error, T1=Control, T2=Soaking in water for 24 hours, T3=Scarification with sandpaper, T4=Soaking in water for 24 hours followed by scarification with sandpaper*

**Effects of Different Pre-Sowing Treatments on the Plant Height of Okra**

The result for plant height (Table 2), show that there were no significant differences ($p>0.05$) among the various pre-sowing treatments at each measurement point. At three weeks after sowing (WAS), the plant heights were relatively similar, with the control treatment (T1) measuring 11.80 cm, T3 (scarification with sandpaper) at 11.67 cm, T4 (soaking in water for 24 hours followed by scarification) at 11.53 cm, and T2 (soaking in water for 24 hours) recording the lowest height at 11.50 cm. At six weeks after sowing, the highest plant height was observed in both treatments T1 and T4, each measuring 27.87 cm, while treatment T2 exhibited the lowest height at 27.20 cm. Treatment T3 recorded a height of 27.70 cm, indicating a slight advantage over T2. By nine weeks after sowing, treatment T4 demonstrated the greatest plant height at 45.53 cm, followed closely by treatment T2 at 43.73 cm and treatment T3 at 42.63 cm. The control treatment (T1) measured 41.83 cm, which was lower than T4.

**Table 2:** Effects of different pre- sowing treatments on the plant height of Okra at Kafanchan, 2024 rainy season

| | Plant Height (cm) | | |
|---|---|---|---|
| Treatment | 3WAS | 6WAS | 9WAS |
| T1 | 11.80 | 27.87 | 41.83 |
| T2 | 11.50 | 27.20 | 43.73 |
| T3 | 11.67 | 27.70 | 42.63 |
| T4 | 11.53 | 27.87 | 45.53 |
| SE (±) | 0.825 | 0.729 | 1.589 |

*WAS= week after sowing, SE=Standard Error, T1=Control, T2=Soaking in water for 24 hours, T3=Scarification with sandpaper, T4=Soaking in water for 24 hours followed by scarification with sandpaper*

**Effects of Different Pre - Sowing Treatments on the Number of Leaves/Plant of Okra**

Table 3 shows the effects of different pre-sowing treatments on the number of leaves per plant of okra at three weeks after sowing (WAS), six weeks after sowing, and nine weeks after sowing. The results indicate that there were no significant differences ($p>0.05$) in the number of leaves per plant among the various treatments at each measurement point. At three weeks after sowing, the number of leaves per plant varied slightly among treatments, with T2 (soaking in water for 24 hours) having the highest count at 4.80 leaves, followed closely by T3 (scarification with sandpaper) at 4.90 leaves. The control treatment (T1) recorded 4.33 leaves, while T4 (soaking followed by scarification) had 4.43 leaves. By six weeks after sowing, the highest number of leaves was observed in treatment T3, which recorded 6.00 leaves per plant. Treatment T4 followed closely with 6.30 leaves, while T2 had 5.53 leaves and T1 had 5.80 leaves. At nine weeks after sowing, the number of leaves per plant decreased slightly across all treatments compared to six weeks. Treatment one (control) maintained the highest count at 7.67 leaves, whereas T2 had 7.53 leaves, T3 recorded 7.30 leaves, and T4 had the lowest count at 7.23 leaves.

**Table 3:** Effects of different pre- sowing treatments on the number of leaves/plant of Okra at Kafanchan, 2024 rainy season

| | Number of Leaves/Plant | | |
|---|---|---|---|
| Treatment | 3WAS | 6WAS | 9WAS |
| T1 | 4.33 | 5.80 | 7.67 |
| T2 | 4.80 | 5.53 | 7.53 |
| T3 | 4.90 | 6.00 | 7.30 |
| T4 | 4.43 | 6.30 | 7.23 |
| SE (±) | 0.526 | 0.439 | 0.526 |

*WAS= week after sowing, SE=Standard Error, T1=Control, T2=Soaking in water for 24 hours, T3=Scarification with sandpaper, T4=Soaking in water for 24 hours followed by scarification with sandpaper*

**Effects of Different Pre-Sowing Treatments on the Leaf Area of Okra**

For leaf area, the results also show that there were no significant differences ($p>0.05$) in the leaf area of okra among the various treatments at each measurement point (Table 4). At three weeks after sowing (WAS), the control treatment (T1) had a leaf area of 30.80 $cm^2$, which was slightly higher than T2 (soaking in water for 24 hours) at 29.03 $cm^2$ and T3 (scarification with sandpaper) at 30.07 $cm^2$. Treatment T4 (soaking followed by scarification) recorded the lowest leaf area at 24.43 $cm^2$. By six weeks after sowing, the leaf areas increased across all treatments, with T3 showing the highest value at 114.87 $cm^2$, while T1 measured 104.00 $cm^2$, T2 at 103.37 $cm^2$, and T4 at 112.73 $cm^2$. At nine weeks after sowing, treatment T4 exhibited the largest leaf area at 120.03 $cm^2$, followed by T3 at 109.43 $cm^2$, T1 at 110.73 $cm^2$, and T2 at 105.23 $cm^2$.

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**Table 4:** Effects of different pre- sowing treatments on the leaf area of Okra at Kafanchan, 2024 rainy season

| | Leaf Area ($cm^2$) | | |
|---|---|---|---|
| **Treatment** | **3WAS** | **6WAS** | **9WAS** |
| T1 | 30.80 | 104.00 | 110.73 |
| T2 | 29.03 | 103.37 | 105.23 |
| T3 | 30.07 | 114.87 | 109.43 |
| T4 | 24.43 | 112.73 | 120.03 |
| **SE (±)** | 3.245 | 6.297 | 10.764 |

** WAS= week after sowing, SE=Standard Error, T1=Control, T2=Soaking in water for 24 hours, T3=Scarification with sandpaper, T4=Soaking in water for 24 hours followed by scarification with sandpaper*

## DISCUSSION

### Effects of Different Pre-Sowing Treatments on the Germination Rate and Seedling Emergence of Okra

The results of the effects of various pre-sowing treatments on the germination rate and seedling emergence of okra reveal significant insights into optimizing seed performance for better crop establishment (Table 1). The highest germination rate observed for T4 (soaking in water for 24 hours followed by scarification) indicates that this combination effectively enhances seed viability and accelerates germination. This aligns with previous findings that suggest pre-sowing treatments such as seed priming can significantly improve germination rates by promoting physiological processes within seeds (Mukhtar et al., 2024). The control treatment, which did not undergo any pre-sowing treatment, exhibited the lowest germination rate. This outcome highlights the challenges associated with unprimed seeds, which often experience delayed and uneven germination due to factors such as seed coat impermeability and low moisture availability. Research has shown that untreated seeds typically demonstrate slower germination rates and longer times to emergence, which can adversely affect crop establishment and yield potential (Kaur et al., 2015). In addition to germination rates, the study also assessed seedling emergence times. The fastest emergence recorded was T2 (soaking in water for 24 hours) emphasizes the importance of hydration in initiating growth processes. Rapid seedling emergence is crucial for establishing a strong plant population, as it reduces competition from weeds and enhances overall vigor (Naz et al., 2012). Conversely, the slower emergence observed in the control treatment could lead to increased susceptibility to environmental stressors and pests, further complicating crop management.

### Effect of different Pre-Sowing Treatments on the Growth Parameters of Plant Height, Number of Leaves, and Leaf Area of Okra.

The effects of different pre-sowing treatments on the growth parameters of okra (plant height, number of leaves, and leaf area) indicate that there were no significant differences ($p>0.05$). Result for plant height among the various treatments at each week interval reveals that at three weeks after sowing (WAS), the heights were relatively uniform across treatments, with the control (T1) measuring 11.80 cm, while other treatments showed only slight variations. This lack of significant height differences at early growth stages suggests that the initial impact of pre-sowing treatments may not manifest immediately but could require more time to influence growth outcomes.

At six weeks after sowing, both the control treatment and T4 (soaking in water for 24 hours followed by scarification) measured 27.87 cm, indicating that these treatments may have similar effects on plant height during this period. However, treatment T2 (soaking in water for 24 hours) recorded the lowest height at 27.20 cm. This observation aligns with findings from Mukhtar et al. (2024), who noted that while some pre-sowing treatments can enhance early growth, others may not provide a significant advantage in terms of plant height during initial growth phases. At nine weeks after sowing, treatment T4 exhibited the highest plant height at 45.53 cm, followed closely by T2 at 43.73 cm and T3 at 42.63 cm. This trend suggests that while early growth may not show significant differences, longer-term effects of pre-sowing treatments could become more pronounced as plants mature. The control treatment (T1) measured 41.83 cm, which was lower than T4 but still comparable to other treatments. This gradual increase in height with certain treatments over time reflects findings by Okereke et al. (2023), who emphasized that effective pre-sowing practices can lead to improved growth metrics as plants develop.

Regarding the number of leaves per plant, the results similarly showed no significant differences among treatments throughout the study period. At three weeks after sowing, treatment T2 had the highest leaf count at 4.80 leaves per plant, while T1 recorded 4.33 leaves. By six weeks, T3 demonstrated the highest count at 6.00 leaves per plant, which indicates that certain treatments. At nine weeks after sowing, treatment T1 maintained the highest count at 7.67 leaves per plant despite earlier trends showing variability among treatments. This suggests that while certain pre-sowing methods may enhance early leaf development, other factors, such as environmental conditions and nutrient availability, could also play significant roles in determining overall leaf production as plants mature.

For leaf area measurements, similar patterns emerged where no significant differences were observed among treatments at each measurement point. At three weeks after sowing, T1 had a slightly higher leaf area compared to others; however, by six weeks, T3 exhibited the largest leaf area at 114.87 $cm^2$. This finding supports previous research indicating that while initial conditions may not significantly affect leaf area development, certain treatments can enhance leaf expansion over time (Okunade et al., 2022).

## Conclusion

The results from the study indicated that pre-sowing treatments, particularly soaking in water for 24 hours followed by scarification, significantly enhance germination rates, achieving the highest rate of 88.00%. This treatment not only improved seed viability but also accelerated seedling emergence, with the fastest emergence recorded at an average of 7.33 days. Conversely, the control treatment exhibited the lowest germination rate and slowest emergence time, highlighting the potential challenges associated with unprimed seeds.

In terms of growth parameters, while no significant differences were observed in plant height, number of leaves, and leaf area among the treatments at each measurement point, trends suggest that certain treatments may promote better growth over time. Notably, treatment T4 (Soaking in water for 24 hours followed by scarification with sandpaper*)* showed the greatest increase in plant height at nine weeks after sowing. The number of leaves per plant and leaf area measurements also reflected similar patterns, indicating that while initial growth stages did not exhibit significant differences, longer-term effects of pre-sowing treatments might become more pronounced as plants mature.

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