# Effects of different pretreatment methods on germination of wheat (*Triticum aestivum*, Poaceae)

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## ABSTRACT

Seed dormancy in wheat (*Triticum aestivum* L.) is a major problem attributing to yield loss. It is a complex evolutionary trait that temporarily prevents seed germination, thus allowing seedling growth at a favorable season. This experiment was conducted to determine the effect of different pre-treatments on germination. The pre-germination treatments included mechanical scarification, soaking seeds in hot water at 100°C for 5 minutes, cold water for 24 hours and untreated (control). Two hundred seeds were used for each treatment. Seeds treated with cold and hot water commenced germination after 4 days and achieved 84%–,78.5% respectively germination within 10 days which was significantly different ($P < 0.05$) from other treatments, especially the untreated seeds which had the lowest germination of 30%, and commenced first germination after 10 days. The results showed significant differences ($P < 0.05$) in germination percentage and germination time. Results obtained in this experiment indicate that the pre-germination treatment of Farasi wheat seeds by using cold and hot water treatments can enhance germination of the seeds by breaking dormancy.

*Keywords: germination percentage, germination time, pretreatments, Seed dormancy, wheat*

## 1. INTRODUCTION

Wheat (*Triticum aestivum* L., Poaceae) is the most economical important cereal crops in the world; however, its production is affected by a multitude of biotic and abiotic factors including the occurrence of wet and moist conditions prior to harvest that causes pre-harvest sprouting (Gao and Ayele, 2014). Cereal farmers' world wide experience yield losses attributed to poor germination of seeds due to various environmental conditions and seed dormancy (Savage and Leubner, 2006).

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Kenya's wheat production deficit has increased over the years, with local production currently accounting for less than 20% of the total supply, and therefore necessitating imports from other countries–. This high dependency leads to nutrition deficiency in most poor families which cannot afford the cost of purchasing the imported wheat flour. In order to enhance local wheat production and reduce overreliance on imports, it is necessary to ensure production is enhanced by addressing among other constraints the challenge of dormancy which is prone in seeds susceptible to pre-harvest sprouting (Kocheshkova et al., 2017).

Seed dormancy research in wheat often involve after-ripening, a period of dry storage during which seeds loose dormancy, or comparative analysis of seeds derived from dormant and non-dormant cultivars (Gao et al., 2012). Coat factors like germination inhibitors, reduced permeability of seed coat to water or oxygen contribute to dormancy in wheat grains. Wheat grain seed sometimes due to some environmental factors like drought and the seeds hormonal imbalance tend to take long to germinate and sometimes fail to germinate completely. This

Comment [u1]: It is not cited in Bibliography study was therefore carried out to investigate the effect of pre-treatment methods on germination in wheat grain seed.

## 2. MATERIAL AND METHODS

To study the pre-treatment effects on wheat germination, a research was conducted in botany laboratory at University of Nairobi Upper Kabete campus, College of Agriculture and Veterinary –Sciences. A total of 800 seeds of "Farasi" wheat cultivar were sourced from Kenya Seed Company and tested for three pretreatment methods with untreated seeds used as a control. Each pre-treatment and the control were replicated four times and the experiment was laid in Completely Randomized Design (CRD).

### 2.1 Pretreatment procedures

#### 2.1.1 Mechanical Scarification

A total of 200 wheat sSeeds were scrubbed to modify the seed coat to enhance water permeability before sowing. The seeds were spread on a clean and sterilized hard brown paper on top of a flat laboratory bench. A sand paper was placed on top (opposite to the embryonal end) of the seeds and scrubbing done to the seeds. Scrubbing was continued until the seed coat colour changed from light brown to greyish in colour.

#### 2.1.2 Cold water treatment

A sample of 200 randomly selected seeds was placed in one of the plastic germination containers before sterilized? distilled water was added to half way full. The container was tightly closed using a lid. The soaked seeds were left on the laboratory maintained at approximately 25$^{o}$C for 24 hours. The seeds were removed and air dried before subdividing them into 4 replicates of 50 each. Each of the seeds in a replicate were placed in a different plastic germination container and closed ready to be sowed.

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#### 2.1.3 Hot water pretreatment

A sample of 200 seeds randomly selected wheat seeds were soaked in hot water at 100$^{0}$C for 5 minutes. Seeds were placed in fabric bags and immersed in preheated water at 80$^{0}$C and left to cool gradually at room

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temperature for 24 hours. Pretreated seeds were air dried before they were sown for germination (Schelin et al., 2004).

### 2.1.4 Control

For control, seeds were not treated; this is to allow comparative effect of no pretreatment of wheat seeds on germination.

## 2.2 Sowing and germination

The seeds for each treatment and their replications were sown in plastic germination containers lined at the base with absorbent papers. Enough distilled water was added to moisten the papers to promote germination. The seeds were spread out onto the absorbent papers to ensure each seed occupied its own space for uniform and equal chance to germinate. Seeds were kept on the laboratory bench and germination monitored for up to 20 days.

## 2.3 Data collection and analysis

Data was collected on germination percentage and mean germination time for pre-treated seeds to germinate.

### 2.3.1 Germination percentage

Germination of the sowed seeds was recorded in three phases after 5, 10 and 15 days. Seedlings were pricked-out after counting to avoid error. Germination was allowed to proceed for 20 days, and then the experiment was terminated. A seed was considered to have germinated if the hypocotyls hook have emerged completely (Fredrick et al., 2016).

Data collected on germination was used to calculate mean germination time and germination percentage (G %) based on the following formula:

$$\text{Germination percentage} = \frac{\text{Total number of germinated seeds}}{\text{Total number of sowed seeds}} \times 100\%$$

Mean germinations were separated by calculating Least Square Differences at 95% confidence levels.

### 2.3.2 Mean Germination Time

$$Mean\ germination\ time = \frac{\sum (ti \times ni)}{\sum ni}$$

Where ti is the number of days starting from the date of sowing and ni is the number of seeds germinated at each day (Bewley and Black 1994).

Data collected were statistically analyzed using SAS software 13$^{th}$ edition to explore maximum possible variation.

## 3. RESULTS

### 3.1 Germination percentage

Significant variation ($P<0.05$) on germination percentage was recorded among the varied pre-treatments. Seeds soaked in cold water recorded the highest value (84%) with the control recording the lowest percentage (30%) after 15 days of germination (**Table 1**). In this study, germination occurred first at 4 days after sowing among the seeds soaked in hot and cold water. However the untreated seeds (control) germinated after 10 days. Seeds treated with cold and hot water took a period of 10 days while the control took 15 days (**Table 1**).



**Table 1: Effectiveness of pre-germination treatments on Germination**

| **Treatments** | **No. of seeds treated and sown** | **Total No. of seed germinated** | **Germination %** | **Days after sowing** | **Germination period (days)** |
|---|---|---|---|---|---|
| Scarification | 200 | 138 | $69^{b}$ | $5^{b}$ | $13^{b}$ |
| Hot water | 200 | 157 | $78.5^{ab}$ | $4^{b}$ | $10^{c}$ |
| Cold water | 200 | 168 | $84^{a}$ | $4^{b}$ | $10^{c}$ |
| control | 200 | 60 | $30^{c}$ | $10^{a}$ | $15^{a}$ |

Means followed by different superscripts are significantly different at 0.05 level of significance

### 3.2 Germination time

Germination of seeds occurred between 4 to 15 days. The germination time among the pre-treatments varied significantly ($p<0.05$). By day 5, untreated seeds (control) had not germinated and scarification had the least germination rate of 62 plants while seeds soaked with cold water recorded the highest number of plants of 106 (**Table 2**). Hot and cold water treatments had the highest effect on germination by taking only 10 days to complete its germination time. Overall germination period for hot water and cold water were not significantly different (**Table 1**).

**Table 2: Effects of varied pre-germination treatments on germination time**

| Treatments | No. of seeds treated and sown | Mean germination time | | | No. of seed germinated |
|---|---|---|---|---|---|
| | | 5 days | 10 days | 15 days | |
| Scarification | 200 | $62^{b}$ | $40^{b}$ | $36^{b}$ | $138^{b}$ |
| Hot water | 200 | $97^{a}$ | $70^{a}$ | - | $157^{a}$ |
| Cold water | 200 | $106^{a}$ | $62^{a}$ | - | $168^{a}$ |
| Control | 200 | - | $14^{c}$ | $46^{a}$ | $60^{c}$ |

Means followed by different superscripts are significantly different at 0.05 level of significance.

## 4. Discussion

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Seed coat hardness is an important factor that affects germination in seed (Aref et al. 2011). Seed pretreatment are species specific and no one type of treatment has been reported to be universally effective (Uniyal et al., 2000). Therefore breaking the seed dormancy by softening the seed testa to allow water imbibition is very crucial (Aref et al. 2011).

Soaking seeds in either cold or warm water improves germination in agreement with experiments done for germination of dormant *Albizia lebbeck* Benth. (Fabaceae) (Missanjo et al., 2013). Soaking softens hard seed coats making it permeable to water allowing seeds to imbibe and swell as the water cools leading to more rapid seed germination (Schimdt, 2000).

Scarification also improves germination by allowing entry of water and exchange of gases resulting in enzymatic hydrolysis and thus transforming the embryo into a seedling (Hodge et al., 2009).

The enhanced germination observed in seeds soaked in cold and hot water could be attributed to water uptake by the quiescent dry seed, which ended up with the elongation of the embryonic axis (Botsheleng et al.,2014)

The subsequent increase in the germination percentage and decrease in mean germination time when subjected to different pretreatment methods is an indication that the hard seed coat is responsible for the dormancy in wheat seeds.

## 5. CONCLUSION

Soaking seeds in hot and cold water are the most effective methods in improving seed germination of wheat species by increasing germination percentage and reducing dormancy period (mean germination time). Soaking before sowing enables more rapid imbibition than is usually the case in a nursery bed, resulting in more rapid seed germination. Therefore, wheat farmers may be advised to be soaking wheat seeds in cold water since it is less complicated and improves germination.

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## COMPETING INTERESTS

The authors declare that they have no competing interests

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