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# **Simple methods of breaking dormancy of passion fruit seeds for resource restrained nurserymen in remote Africa**

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## **ABSTRACT**

Passion fruits are among the fruits on high demand in Uganda and international markets. The challenge with passion fruit production is that their seeds are characterized by hard seed coat which inhibits the embryo to access water and oxygen. This leads to delay in germination or failure of seeds to germinate in nursery so nurserymen fail to raise the target seedlings. This study aimed at assessing the low cost methods of breaking dormancy of passion fruit seeds. The study tested use of hot water, citric acid, sucrose solution as measures to break seed dormancy of passion seeds in comparison with control seeds (untreated). After the seed treatment, seeds were sown in the nursery bed in 4 replications at the Horticulture demonstration unit of Mountains of the Moon University. The data was collected as germination percentage, duration and vigor. Analysis done with aid of Genstat software to perform one-way ANOVA to identify significant differences in germination percentage and vigor among the seed treatment methods.

Seeds soaked in soaked in citric acid had the highest germination percentage with 82.6% and lowest germination percentage in control seeds with 8.0%. There were significant differences in germination percentage among treated seed samples with p value less than 0.05 (one-way ANOVA).

Based on the finding, the three methods tested in the study i.e. Using citric acid, use of sucrose solution and hot water proved very effective methods of breaking seed dormancy of passion fruits. Citric acid was the most effective method as characterized by high germination and early germination. There is need to try citric acid on seeds of other species of passion fruit.

**Key words:** seed dormancy, dormancy measures, passion fruit, affordable methods.

## INTRODUCTION

Passion fruit is scientifically known as *Passiflora edulis* belonging to the plant family of passifloraceae (<https://plants.usda.gov/java/ClassificationServlet>) and (Morton, 1987). There are two major varieties of the crop i.e. purple and yellow/gold varieties (Morton, 1987). Purple variety is the most cultivated in Uganda probably due to its high demand in the market and fetches good price (Kato, 2014 and Bbosa, 2018). Passion fruit seeds have a hard seed coat hinders the embryo to access to water and oxygen necessary for its germination (Rego et al, 2014, Marostega, et al, 2017 and Marina, 2018). Several methods are used to break this kind of seed dormancy such as use of sulphuric acid, physical scarification, gibberellic acid and  $KNO_3$  (Manoel et al, 2010, Marostega, et al, 2017, Marina, 2018, Pallavi et al, 2014). Some are difficult for nursery men to implement due to skills and resources associated with the methods. This study experimented methods whose materials locally available to the small scale nursery operators. These methods were use of citric acid, using sucrose solution and hot water treatment.

## MATERIALS AND METHODS

### Description of experiment

This experiment assessed 3 treatments on passion fruit seeds: soaking passion fruit seeds in undiluted citric acid, some seeds soaked in 10% sucrose solution, Other seeds were subjected to hot water at temperature of 70°C for 10 seconds and control seeds which were not treated. After carrying out the treatments, seeds were sowed in sandy loam seed bed so that seedlings can easily emerge. This was done at Horticulture demonstration unit in Mountains of the Moon University. Seeds of each treatment were sown in 4 replications in a randomized complete block design (figure1).



Figure 1. Sowing of passion seeds in the seed bed after treatment.

## **Seed extraction**

The seeds used in the experiment were extracted from purple passion fruits variety bought from the farmers' market in Kabudaire Fort Portal municipality. Ripe fruits were split open and seeds were removed. This was followed by washing the seeds with rain water to remove pulp to enhance effectiveness of seed treatments. Finally wiping of seeds with a cloth to further remove the residues of pulp from the seeds.

## **Application of the treatments**

For citric acid treated seeds, the juice was extracted from lemon fruits by pressing the fruits after half cut. Seeds were soaked in concentrated lemon juice with no water added to dilute it. Soaking of seeds was done for 15 hours and finally sowing of seeds next day.

Sucrose treated seeds: seeds were in soaked in 10% sucrose solution over night . The solution was prepared by adding 10 gram of sucrose sugar into 100 grams of water. Therefore a digital scale was used to determine such amount of sugar in water. Soaking seeds was done for 15 hours and sowing followed next day.

Hot water: the rain water was boiled and cooled to 70°C with cold water after seeds subjected to that water for 10 seconds. Immediately sowing was done in the seed bed.

Some seeds were not soaked in citric acid, sucrose solution and subjected to hot water so they were termed as control seeds. They were sown in the seed bed at the same time with treated seeds to establish comparison standards.

## **Data collection and analysis**

Data was collected in form of germination percentage (figure 2) the germination duration, and germination vigor . Germination percentage (GP) was obtained by formula stated below:

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

Total number of seeds sowed (25 seeds) per block.

For germination vigor obtained by measuring the weight of the 2 months old seedlings at the end of the experiment using digital scale. While germination duration was determined by considering how long seeds took to germinate.



Figure 2. Counting germinated seedlings to determine germination percentage

Soft ware Gen Stat the 18<sup>th</sup> edition was used to perform one way ANOVA to establish significant differences in germination percentage and vigor among treated seed samples of passion fruits.

## **RESULTS**

### **Germination percentage**

Seeds treated with citric acid had the highest germination percentage with 82.67% and the lowest in control seeds with 8% (figure 3) There were significant differences in germination percentages among the treatments with  $p < 0.05$  (one way ANOVA) as indicated by different letters in figure 3.

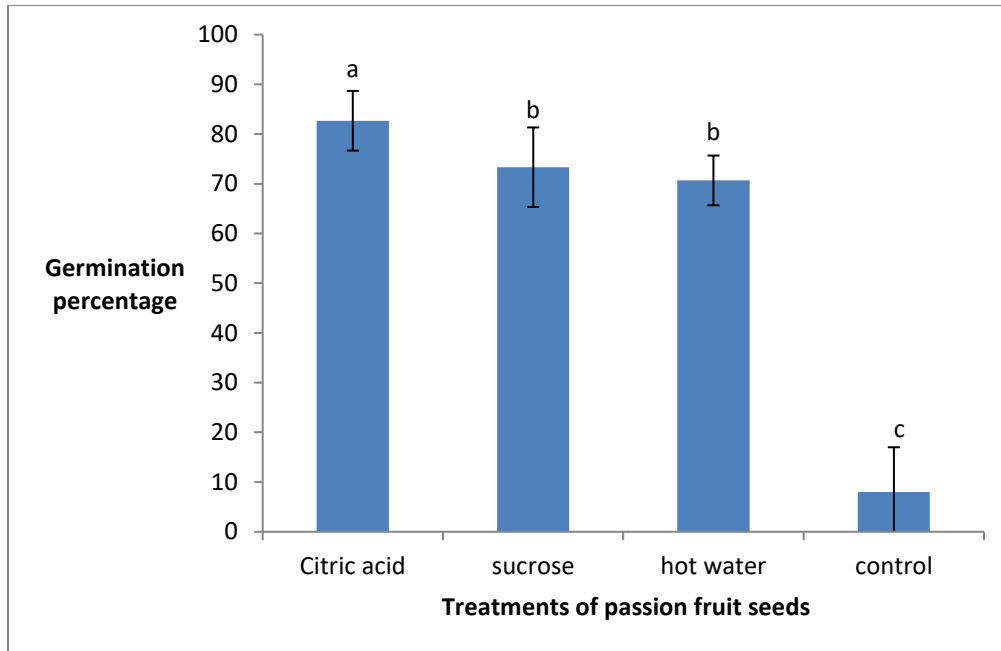


Figure 3. Mean germination percentage of passion fruit seeds with error bars stand for standard deviation

### Germination vigor

The highest germination vigor was observed in the sucrose seeds with seedlings weight of 0.28 gram, and lowest was in control seeds with 0.07 grams (figure 4). There were no significant differences in germination vigor among the treatments with P greater than 0.05 as indicated by same letter in figure 4.

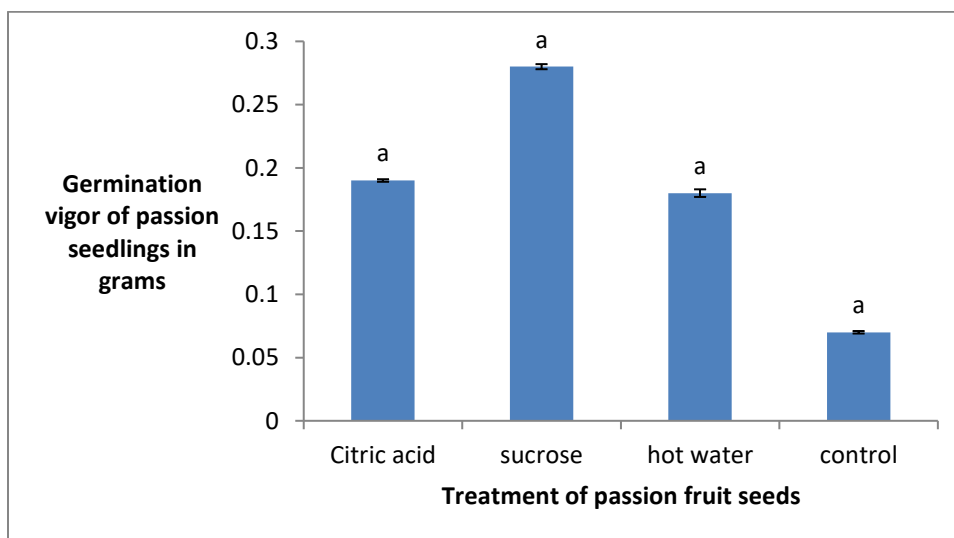


Figure 5. Mean germination vigor of passion fruit seedlings from treated seeds.

## Duration of germination

Seeds soaked in citric acid took the shortest time to germinate 20 days, hot water treated seeds soaked in germinated in 22 days, sucrose treated seeds germinated in 24 days the control seeds took the longest time 28 days to germinate after sowing as those seeds soaked in sucrose solution took 24 days to germinate

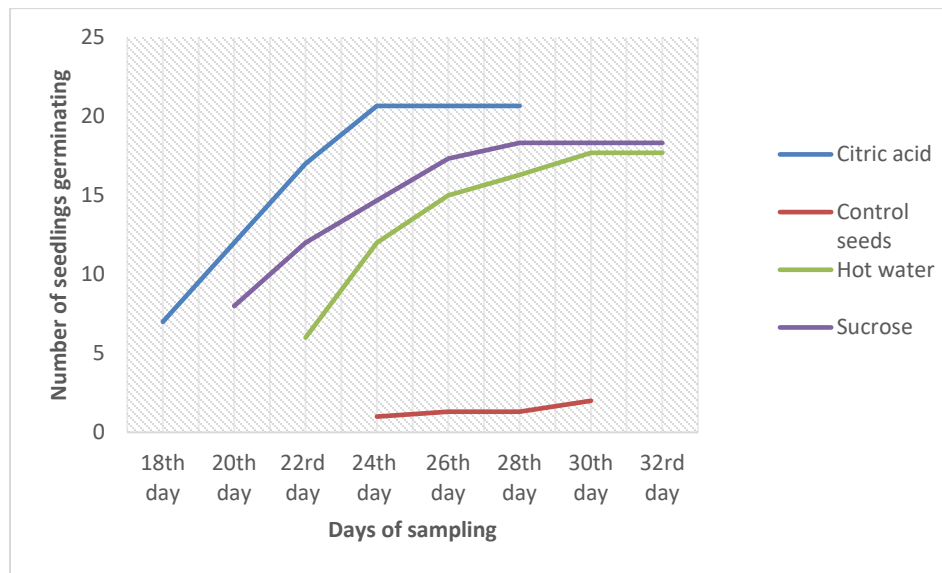


Figure 6. Germination rate of treated and control seed samples

## Height of seedlings

Seedlings treated with sucrose, were tallest 10.80 centimeters followed by seedling emerged from hot water seeds 9.50 centimeters, then control seedlings 9.00 centimeters and the shortest were seedlings from citric acid 8.40 centimeters (figure 7) There were no significant differences among in seedlings' height from different seed treatments with p greater than 0.05 as same letters in figure 7.

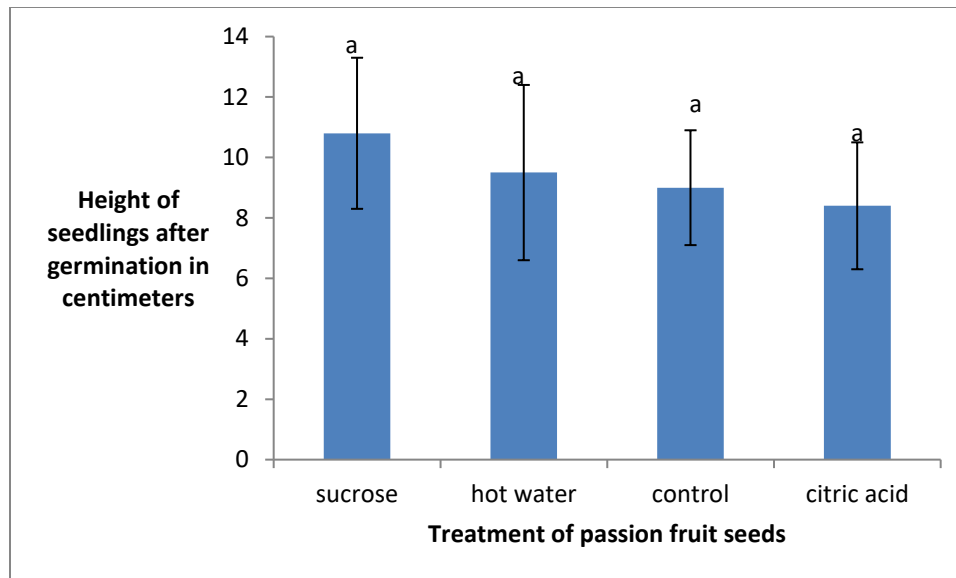


Figure 7. Height of seedlings from different seed treatments

## DISCUSSION

### Effective methods in the study

Seeds treated with citric acid had the highest germination percentage of 82.67% and took the shortest time to germinate 18 days. This can be attributed to the corrosive effect of acid on the seed coat to allow the embryo to access water and oxygen (Eşen et al, 2009, Purohit et al, 2015 and Niu et al, 2018). Therefore, the use of citric acid to break down the dormancy of passion fruit seeds is the most effective method. However, seedlings germinated from citric acid-treated seeds had lower vigor and shorter seedlings as compared to the sucrose-treated seed. This is because sucrose provides carbon for seedling metabolism (Pinfield-wells et al, 2005) thus a sucrose solution can break immature embryo dormancy. Use of a sucrose solution was more effective than hot water with 73.33% germination and a seedling height of 10.4 centimeters.

Hot water-treated seeds performed better than untreated seeds (control) with 70.67% germination and germinated in 22 days. It can be explained by the fact that hot water softens the seed coat for the embryo to emerge with less energy (McDonnell et al, 2012). So it is necessary to carry out that seed treatment. Control seeds had a poor germination of 8.00% and took the longest time of 24 days to germinate.



## CONCLUSION AND RECOMMENDATIONS

Based on the finding, the three methods tried in the study i.e. Using citric acid, use of sucrose solution, hot water are very effective methods of breaking seed dormancy of passion fruits. Citric acid was the most effective method as characterized by high germination and early germination. Treating passion fruit seeds with sucrose solution produce quality seedlings compared to the use of citric acid. There is need to try citric acid on seeds of other species of passion fruit.

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